Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, DECEMBER 13, 1902. No. 24.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
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ELECTRICAL WORLD AND ENGINEER.

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 13, 1902.

CONTENTS.

Editorial 935
Twenty-Fifth Anniversary of the Engineers' Club of Philadelphia..... 938
Recent Methods of Trackless Trolley Operation..... 939
Independent Telephony in Buffalo. By James Malcolm..... 941
Self-Forming Separator in a Nickel-Peroxide Storage Cell. By A. L. Marsh 942
Water Vapor. By Alfred G. Dell..... 943
Electrochemistry in Lithography. By E. C. Handy..... 943
The Armature Reaction of Alternators—VI. By C. F. Guilbert..... 944
Wire and Cable Specifications. By L. T. Collins..... 945
Electrical Oscillations. By Woolsey McA. Johnson..... 946
Three-Phase Measurements. By A. S. McAllister 947
The Operation of Alternators in Parallel 949
Electric Light in Canada 949
The Use and Advantages of the Alternating Current for Land Telegraphy —VI. By Edwin F. Northrup. (Concluded)..... 950
Chicago Meeting of the American Institute of Electrical Engineers..... 952
Telephone Cables—II. By Arthur V. Abbott, C. E..... 954
The Manufacture and Laying of the Vera Cruz-Frontera-Campeche Cable for the Mexican Government..... 958
Meeting of the American Society of Mechanical Engineers..... 960
Lighting the St. Louis Exposition..... 961
Recent Electromchemical Developments. By Clinton Paul Townsend.... 962
Independent Telephony in New York State..... 962
New Equipment for the Study of Illumination..... 962
New Telephone Patents..... 963
Current News and Notes..... 964
LETTER TO THE EDITORS:
Variable Speed Motor Control. By E. R. Knowles..... 965
Digest of Current Electrical Literature..... 966
New Book 970
Maximum Demand Indicator..... 970
Transposition of Line Wires..... 971
Annual Meeting of Electrical Trades' Society 971
Hand Microtelephone 971
A New Telephone Hook-Switch..... 971
Increase of Traction by Magnetism..... 972
A Countershaft Geared Motor..... 972
Enameled Steel Lamp Shades..... 972
The Butler Drill Chuck..... 972
DEPARTMENTS 973
Second Convention of the Interstate Independent Telephone Association Supplement.

THE TELEPHONE MOVEMENT.

If any proof were needed of activity in the telephone field, it is afforded by such meetings as that which is taking place in Chicago this week and of which record is made in a supplement to this issue. The exuberant enthusiasm and progressiveness in the independent field, thus finding expression, matches that shown in the earlier days of the art, when, as some will remember, a Bell telephone convention could hold its own as a "hot time" with anything else that has taken place in the shape of electrical gatherings. It has always been a matter of regret with us that the Bell conventions ceased, and we could always see plenty of good reasons for their continuance, even though it be conceded that with concentrated ownership or control the time had gone by for such free and vigorous treatment of the subject as has been seen in Chicago this week. We are glad to note this activity and intensity in a department of electrical industry still so far from being developed up to its possibilities, and so greatly in need of uniformity and standardization. It is perhaps natural that greatest interest in these meetings should be shown in the Western States, where the independent movement has reached its most striking advance. We could, however, hardly expect to see the convention fever maintained at its present height, even there, and the natural drawing together of a great many of the local companies, still separate, must in time bring its inevitable effect. Indeed, it is avowedly the aim of many of the leaders thus to use the conventions for crystallizing consolidations that will make for efficiency and economy; and there can be no doubt that results in this direction will attend their efforts.

Outside of the exchange field, the independents have also tremendously stimulated telephonic activity, and the amount of "isolated" or "interior" work they have done is most creditable. It does not find much illustration at conventions of exchange men, whose interests lie, in reality, rather the other way; but none the less, it is the independent movement that has been so powerful a factor in furnishing the telephone to the trolley road, the factory, the hotel, the mine, the electric light plant, or the office building. The interaction of this upon exchange work will be interesting in due time.

METRICS AND THE MECHANICALS.

We regret to see that so reputable a body as the American Society of Mechanical Engineers should have even temporarily passed under the fanatical domination of the rule-of-thumb contingent, for it thereby becomes, we fear, an object of international merriment. It is to-day probably the only quasi-scientific body on the face of the planet which would so far stultify itself as to go on record as openly opposed to the metric system. To be sure, it did so only by a trivial majority of a rather lean meeting at which the conservative enragés were present in force, but this palliating circumstance will hardly secure the publicity that will serve to lessen the pained astonishment of the scientific public. We earnestly commiserate the minority for the unfortunate position in which it has been put. Father Time and the fool-killer will rescue it at no distant date, and the intemperate vituperation indulged in by the old fogies serves in part as its own corrective. The resolutions which actually passed were in fact rather mildly condemnatory, but those which the saner counsels of the Society tabled, but did not keep from widespread publication, were unique. If the metric advocates wished to retaliate, they might assert that for senile fanaticism,

futile rancor and general imbecility those resolutions stand quite alone. There may be, and are, reasonable differences of opinion as to the wisdom of an immediate and violent change in our system of weights and measures, which, by the way, nobody has seriously proposed; but we certainly did not suppose that five engineers could be found who would go upon record in such extraordinary language and as believing that the so-called "English system" would ever be universally adopted.

"English system" indeed! There is no such thing, nor has there been within the memory of man. It would take more space than we have in our editorial columns to catalogue and describe the weird and irreconcilable systems which have been in use in English shops. We very much doubt whether any member of the American Society of Mechanical Engineers could ever name them off hand, much less explain their relations. It seems as if half the prosperous manufacturers in England had devised independent systems of gauges, admirably supplemented by popular units handed down from mediaeval times. Of these, the barley-corn is about the only one which has not been retained in use to our knowledge, though we should not be in the least surprised to find that it still survives in some form or other. The chief argument advanced by the seventeenth-century section of the A. S. M. E. seems to have been the occasional survival of similar curios among nations using the metric system for the purposes of every day life. Now unquestionably there are some such anachronisms, like the Paris line and the German zoll (Heaven knows which one), but they have no more significance than the use of the double negative among English illiterates. As well abolish the metric system for one, as English grammar for the other. Particular trades preserve their metrological jargon as particular communities adhere to their dialects, but neither fact has the slightest general significance save to attest the persistence of bad habits. So far from any form of English measures making headway in the world's work, every succeeding year finds the metric system making steady progress in commerce and industry. Continental manufacturers sometimes build to English measures for the export trade, just as they make beads of particular sizes and colors for barter in Central Africa, merely as a concession to the idiosyncracies of savages.

This whole rumpus proves the wilful and deplorable ignorance of the rule-of-thumb contingent as to the real provisions of the metric bill now before Congress. It is tacitly assumed that its effect will be to change violently by legal enactment all the measuring equipment of the shops of the country; and on this assumption the aforesaid back numbers found a mighty grievance. Now it is undoubtedly the purpose of the bill to encourage the introduction of a simple international system of weights and measures, but its actual direct effect will be merely to set a good example by the use of the metric system in the transactions of the Government. Any superannuated fanatic who so desires is at perfect liberty to continue his antiquated methods just as long as he wishes. Nobody cares how his shop rules are graduated. He can have them divided to thirteenths of an inch or seventy-ninths of a foot if he likes, with no one to hinder. But if he deals with Uncle Sam, he will be expected to conform to civilized units so far as the results are concerned. This, however, is not, perhaps, the place where the shoe pinches. It takes very little forethought to see that a system used for all official business, and conforming to common international practice, will very rapidly work its way into general use, and when that time comes, the gentleman who deals in barley corns will be, with respect to domestic trade, just where he is now with respect to a large class of foreign trade, seriously at a disadvantage with his more progressive competitors. If he really believed that the metric system would not come into well nigh universal employment, a law such as is proposed would give him no pangs, but the gentleman who deals in barley corns sees the beginning of the end, and squirms. We believe that the best interests of science, the mechanical arts, and commerce will be served by the immediate passage of the proposed measure, that it will be passed in spite of the frenzied ravings of the small group of hide-bound fanatics who oppose it, and that the result will be the success of the similar movement in England and her colonies and the reduction of the so-called "English" system to a position of merely archeological importance. Let the yard, foot and pound be stored with the cubit and span in a Pantheon of departed units, and then be forgotten, except as relics.

Engineering Solidarity.

Not a little has been said lately about engineering solidarity and the great opportunities that exist for the closer working together of men engaged in different fields of engineering work. But we doubt whether a better expression has been given to ideas that are now in the air than the speech made by President Scott, of the American Institute of Electrical Engineers last week in Philadelphia—a fitting place for the utterance of such fraternal sentiments. The occasion was the twenty-fifth anniversary of the local Engineers' Club, and the number of prominent men present, from all branches of the engineering profession, gave more weight than usual to every idea receiving applause and approval.

We have quoted on another page some of the leading passages of the Scott speech, and regret we have not room for more, especially the remarks on "co-operation," which was characterized as "the great discovery of the nineteenth century." Mr. Scott was strong in his emphasis upon its great desirability in these days when, as he put it, the effectiveness of concentration and the economy of largeness are brought out by the events of every day. It is, indeed the truth, that engineers being to-day specialists must therefore work together, and are beginning to do so in ways and to an extent that was little dreamed of once. Indeed, it is impossible to contemplate the future without accepting as a fact this unity of purpose and effort.

Perhaps sentiment in this thing counts for a good deal, and we are willing to admit being sentimental on the matter; but Mr. Scott himself showed incidentally that it is also and largely a question of necessity. Virtually the housing of the poor is a mild problem compared with the housing of the engineering societies, many of which in this city—national bodies—wander from pillar to post—without hope or expectancy of enjoying rooftree or hearthstone of their own. The American Society of Mechanical Engineers has a small house it has outgrown and seeks shelter in an adjoining hotel. A well-known citizen of New York who lately gave the Electrical Engineers a handsome addition to their library characterized the Institute offices as a set of "cubby holes," and the appellation is but too pat and true. These cases are but typical and symptomatic and the evil of crowding grows yearly, while the societies become daily less able to care responsibly for the technical and literary treasures committed to their care. The bodies in question do not need charity, nor would they accept it, but there are magnificent opportunities existing to place at their disposal and in their trusteeship facilties for the common good, the benefits of which would at least equal those afforded by any university in the land.

Measurements of Power in Three-Phase Circuits.

Mr. McAllister's article on page 947 skillfully analyzes a simple case of current unbalance in a three-phase system, and shows how inaccurate may be the results of formulæ which apply to wattmeter measurements when dealing with balanced circuit. The power-factor of a single-phase circuit considered between a given pair of

points therein, is a clear and definite quantity, being the ratio of the real to the apparent power transmitted beyond those points. The same definition may be rigidly applied to a three-phase system, balanced or unbalanced, when a neutral point exists. When, however, the three-phase system has no neutral point, but is provided with circuits in delta, the power-factor becomes more difficult to define and more troublesome to determine. Mr. McAllister's article does good service in pointing out this fact. The article also contains a very pretty explanation of the well-known two-wattmeter method of measuring power in a three-phase system. The explanation does not contain or attempt a rigid proof of the accuracy of the reasoning involved, but a little consideration will convince the reader of the accuracy of the reasoning. As the ordinary method of proof is essentially symbolical and hidden from those unfamiliar with trigonometry, this method is one that will be advantageous to the student of three-phase systems.

REVERSALS OF ELECTROLYTIC POLARIZATION.

We are familiar with the fact that the phenomena of magnetization in iron involve the history of the process. In other words, we know that iron has a magnetic memory. On page 946 appears an article by Mr. W. McA. Johnson, giving an account of some interesting observations on what might be termed electrolytic memory. If an electrolytic cell be charged for a certain period and allowed to discharge we know that it will discharge at the expense of electrochemical energy. This energy has been stored in the cells in the form of anions and cations supported on the anode and cathode. If, however, before we discharge the cell, we reverse the charging current for a brief interval, we shall tend either to dissipate, or to consume the layers of superincumbent anions and cations. If the reversal lasts long enough, the layers will vanish and be replaced by new layers of opposite character and polarity. But if the reversal stops short of this destruction there will be a remanent layer of anions on the original anode neither dissipated nor consumed. Beneath this will be a newly developed layer of opposite polarity.

If the cell be discharged in this state there will be first a discharge from the last formed layer and, as soon as this has been exhausted, the remanent layer of the original charge will become active and will reverse the direction of discharge. In order therefore to develop an electrolytic memory in a cell, its chemical nature should be such that, as described in the article, it is irreversible, and that the new anions cannot consume the old cations. Moreover, its mechanical and physical nature should be such that the old cations can lurk in a safe hiding place near the original cathode, and not readily be dissipated by diffusion and convection. It might be possible to develop a long memory in a cell in this way. The article shows that the memory of the cell experimented upon was clear for half a minute, but after that it became vague and only modified the subsequent action without dominating it.

ELECTRICITY ON TRUNK LINES.

Cornelius Vanderbilt has contributed, as we noted last week, to the *North American Review* a study of this subject from the standpoint of the railway manager which is again worth commending to the attention of our readers. It must be remembered, too, that aside from his official status Mr. Vanderbilt is an engineer whose opinion must command respect. In this case his views are singularly conservative and sane, and while the electrical engineer may find some items for criticism, he will, in the main, agree that the conclusions are sound. Roughly to summarize the points of the paper, Mr. Vanderbilt divides the total expense as follows: Cost of unit weight of fuel, useful work realized per unit, cost of handling trains, cost of repairs to machinery, cost of repairs to roadbed. As to the first item he finds approximate equality for electric and steam operation, save in isolated cases where low grade fuel or water power can be economically used for the electric stations. In work realized per unit of fuel, the result is nearly a stand off with perhaps a slight advantage in favor of electricity. Cost of handling trains should not vary with the motive power, since no hands could be dispensed with safely in electrical driving. As to repairs on machinery, the larger total amount in electrical equipment would offset, or more than offset, any intrinsic gain in favor of the motors, and in repairs to roadbed. Appearances indicate little difference, although the third rail, if used, would be an additional item of maintenance. When it comes to the cost of equipment Mr. Vanderbilt considers that on the two systems the cost of rolling stock, including motors and locomotives, would be about the same, leaving the electric generating and distributing systems as additional items of expense which must justify their existence by increasing the power delivered per unit cost of fuel. The possibility of doing this is held very properly, to depend on the density of traffic on the road, which Mr. Vanderbilt considers to be very rarely great enough on trunk lines, if ever, to give electric operation the advantage.

Mr. Vanderbilt fully recognizes the advantages that may be gained in handling a dense passenger traffic by electric trains, but he is here discussing the desirability of electric traction in the general service of "trunk lines." In this paper he has put his finger with unerring instinct on the weak point of electric traction on a large scale —viz: the losses and expense in the transmitting and distributing system when dealing with traffic of small or moderate density. He falls into the error common among those who are not practically familiar with electric power transmission of somewhat overestimating the losses in the line, and thus exaggerates one factor in his estimates, but not by an amount which at the present time vitiates his conclusions. The loss from prime mover to driving wheel is indeed the most serious obstacle to electric traction on a large scale. When traffic is very dense this loss is relatively of much less importance than elsewhere, and may be far outweighed by the undoubted advantages of electric driving, but it is certain that this loss is one which engineers should strive assiduously to reduce. The major part of it, however, generally lies between the step-down transformers and the driving wheels rather than on the side towards the prime mover. All the recent experiments have been directed to the reduction of this fraction of the loss, either by the use of alternating motors, polyphase and other, or by employing rotary converters or motor-generators on the locomotives, thus doing away with the extensive low tension distributing system. Obviously this procedure is not merely an extension of ordinary trolley practice, but a direct attack along a new line on the more serious problems of the art.

As Mr. Vanderbilt very properly points out, trunk line conditions are not to be properly met by a mere extension of ordinary trolley lines, and the more fully this fact is understood the better for electric traction in general. As we have many times pointed out, there is a large class of interurban roads which must in many of their relations be classed with ordinary railroads, and yet there is a very wide distinction between even these and the big trunk lines which derive and must continue to derive, a very large proportion of their revenue from hauling the country's freight. There is every reason to believe that electric traction will steadily increase and that it will yearly assume a more serious position in general railroad work, but this is far from asserting that the locomotive will soon be a back number. And there is good reason to believe that the locomotive is capable itself of very considerable improvements. As a result of the Zossen tests a determined effort is being made to produce a locomotive especially suited to very high speeds, and the results will throw considerable light on the improvements that may fairly be expected.

Twenty-Fifth Anniversary of the Engineers' Club of Philadelphia.

The Engineers' Club, of Philadelphia, celebrated its twenty-fifth anniversary last week by a banquet, which was a notable affair, not only on account of the attendance and speeches, but also because of the elaborate setting and arrangements, which latter were admirably carried out. The menu and programme was a unique and appropriate conception, being printed on tracing paper with blue-print covers, the front cover carrying an elaborate design symbolic of engineering.

The guests included representatives from the national engineering bodies, a large number of engineering clubs, as well as the Union League and Art Clubs of Philadelphia and the University of Pennsylvania. Among the distinguished guests were Admiral Melville and the venerable John Fritz. The American Institute of Electrical Engineers was represented by President Charles F. Scott. Gen. William P. Craighill, U. S. A., who was to respond to the toast "Our Engineers," was unavoidably absent, having been recalled by telegram received from Washington at Baltimore while on his way to Philadelphia. It was thought that ample seating arrangements had been provided for the banquet, but some twenty members had to be turned away for want of room.

President Henry J. Hartley presided, and Mr. L. Y. Schermerhorn acted as toastmaster and in appropriate terms welcomed the guests. In his remarks Mr. Schermerhorn sketched the history of the Engineers' Club, which grew out of an arrangement between the American Society of Civil Engineers and the American Institute of Mining Engineers, whereby headquarters were established in Philadelphia during the Centennial of 1876 for the convenience of American and foreign engineers visiting the Exposition. At present the membership numbers nearly 500.

Mr. Oberlin Smith was called upon to say a few words expressing regret at the absence of Gen. Craighill, in which he pointed out the great work that army engineers have done. Admiral Melville responded to the toast "Our Navy Engineers," and in his remarks paid a high tribute to engineers in general. The other toasts were as follows: "Our Honorary Members," Mr. James Christie; "Commerce," Mr. Robert W. Lesley; "Engineering and Our Kindred Society," Mr. John Birkinbine; "Our University of Pennsylvania," Prof. Arthur W. Goodspeed; "Our Founders," Mr. Wilfred Lewis; "The Technical Press," Mr. John C. Trautwine, Jr.; "The Union League," Mr. Peter Boyd; "The Engineers of the Twentieth Century," Mr. Charles F. Scott.

Mr. Scott, in his opening remarks, modestly commented on the fact that the honor of responding to the toast, "The Engineer of the Twentieth Century" had fallen to an electrical engineer. He then proceeded as follows:

Besides the new relations to others there will be new relations of engineers among themselves. All that I have said so far emphasizes what we all know, namely, that the several branches of engineering are intensely interdependent and co-related. Take a single instance of large work, the extension of the Pennsylvania Railroad into New York City, the tunnels under the Hudson and East Rivers, the terminal facilities and the electrical equipment and endeavor to name an important branch of engineering which is not essential to this undertaking.

The work of the future demands co-operation, not clannishness—unity not jealousy. Engineers must be specialists, therefore they must work together. The several branches of the profession have their individual interests; they have a larger common interest. As we marvel at what the engineer has done, as we attempt to picture what he may do, we realize the far-reaching responsibilities which confront us. Shall we rise to meet them? We gave to the world the steam engine, the steam vessel, the railroad, the telegraph and cable, machinery, industrial processes, the electrical central station—the fundamental requisites which underlie co-operation. Is it not time that we, too, apply to ourselves the great lesson of the last century? What organization stands before the world as representative of the engineering profession? Has the engineer been accorded the recognition and the reward which are his due? A noted lawyer recently addressed the annual banquet of a local engineers' society containing members of national and international reputation. His remarks were based upon the idea that all engineers were co-ordinate with a common chainman, and they would have been positively insulting but for his air of blissful ignorance. A few years ago a gentlemen of eminence in addressing the American Society of Mechanical Engineers advised its members not to join in a machinists' strike. In what way do engineers present themselves to other professions? In what way do engineers co-operate to advance their own profession by mutual helpfulness and by undertaking measures which advance the efficiency and the usefulness of engineering work? There are national organizations of various kinds, the Civil, the Mining, the Mechanical and the Electrical Engineers, the Architects, the Naval Architects and Marine Engineers, the Engineers in the Army and the Navy, and there are the Chemists, the Electrochemists and others. In general each knows that other societies exist, and they are mutually respectful, but there is some suspicion here and there that the others are a little too exclusive or a little too common, or that they are a bit jealous. These are the murmurings of littleness, not of largeness.

The several engineering professions, like the constituent States, have their representative bodies, their legislatures, but why not an Engineering Congress as well? Why not a national representative body to stand for the profession of engineering, to promote a harmonious co-operation which will strengthen each and elevate all?

An incident of the past year is an auspicious omen. Four great societies have co-operated; they have worked together; they have taken a step which will bring recognition to the deserving individual and credit to the engineering profession; they have founded a medal and at a magnificent dinner they have announced the award of the first John Fritz Medal to the venerable man who has just spoken, John Fritz himself. But not less significant than even the medal is the discovery that the societies can work together, and by doing so they can accomplish worthy ends.

In the vision of the future may we not discern a reflection of the John Fritz Medal in the larger life of the Twentieth Century Engineer? Methinks I see the outlines of the medal taking the form of a magnificent building, the capitol of American engineering. Into this home in the metropolis are gathered the great engineering societies from their scattered lodgings. Here is a great technical library, here are ample assembly halls and comfortable parlors, here are the headquarters of a score of lesser societies, affiliated in their work, but restricted in their scope. I see all over the country innumerable local societies and engineering clubs, no longer isolated but joined together into one great combination. I see them affiliated with the national bodies—sometimes as local chapters—all together constituting a great union. There is individual freedom, but general co-operation. The Engineering Congress representing all the engineering professions and supported by the great union of engineering societies, gives to engineers a rank consistent with the importance of their work; it increases the efficiency of the inter-relations among engineers. An eminent body, it is powerful in advancing the common interests of engineers, and it represents the engineering profession in its relations to other professions, to pure science, to education, to legislation, to public improvements and to the general welfare.

Years ago engineers were individuals of trivial consequence compared with men in the learned professions. Now technical professions are of recognized importance. But even yet the national societies of the profession which has made the nineteenth century an era in the world's history, which has provided the means for the production of unmeasured wealth and which promises yet greater things for the future, have not even a home of their own. Within the week the American Society of Mechanical Engineers who have a little house of their own found it so very little that it was forced to hold its meetings in a large room in a near-by tavern. There were present men through whose work hundreds of millions have been added to the wealth of this country, and their present efforts are to increase the efficiency of the future. Is this right? Is it just?

But may not the fault lie somewhat with the engineers themselves? Have they fully recognized their own strength and importance? Have they shown a disposition to act together, to do large work in a large way? Have they given promise that they would use well the enlarged facilities to increase the efficiency of engineering work?

The men who are mastering the powers of nature will yet rise in the strength of united effort to meet the increasing responsibilities of the coming years. For it is theirs to build the foundation of the new civilization; it is theirs to establish material prosperity—the underlying condition for broader, fuller and higher life.

The end of engineering is usefulness, the characteristic of America is activity; the modern method is co-operation. As engineers of the twentieth century let us be useful; let us be active; let us co-operate.

Recent Methods of Trackless Trolley Operation.

FROM time to time the subject of trackless trolley operation has come up in this country, and a few experiments have been made here. In Europe, where the roads are usually much narrower than ours, and where the laying of trolley tracks meets in many places with strenuous and insurmountable objections on that account, the idea has been taken up far more seriously. At the present moment, two methods are before the European public, one the Lombard-Gerin, partially with polyphase current for a special form of motor trolley with flexible cord, and the other that of Mr. Max Schiemann, of Dresden, with direct-current and regular trolley pole contacts. Both are very interesting and the practical results already obtained would imply that more of this work will be seen in the near future. It will be remembered that in 1899

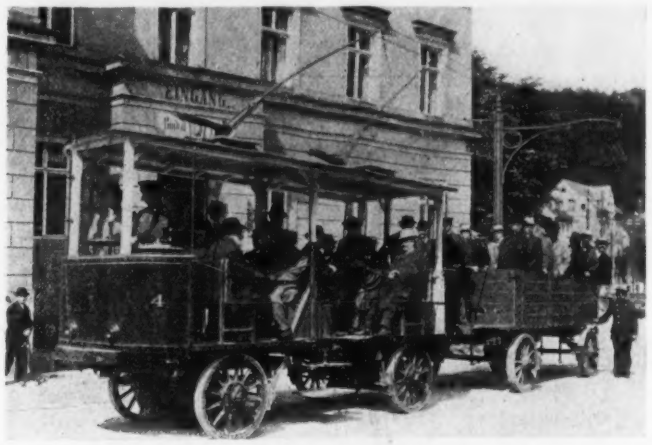


FIG. 1.—TRACKLESS TROLLEY CARRYING PASSENGERS NEAR DRESDEN, GERMANY.

Siemens & Halske brought out in Berlin an automobile omnibus, which besides having overhead wire circuits and trolley pole contacts, was equipped with storage batteries consisting of no fewer than 200 cells. We are not aware that anything has been done with that method since the time mentioned.

The Schiemann system has been operated very successfully in the Biela Valley, near Dresden, running through several villages, and considerable freight is now being hauled over the road. Fig. 1 shows a motor car and a trail car taken on the occasion of a visit to the line by the Dresden Elektrotechnische Verein. The motor car is usually employed for the transportation of light express matter, and the trail car for coal and other heavy goods. The train in actual operation is shown in Fig. 2, taken from a photograph made after a light fall of snow. The train is steered by means of the front wheels of the first car, and it has been found that the wheels

FIG. 2.—TRACKLESS TROLLEY CARS HAULING FREIGHT.

of the second car, being of the same gauge, will track absolutely after those of the first car.

The trolleys are provided with a sliding contact. The motor car has a weight of 4 tons, and is capable of carrying a weight in packages of 1 ton. The trail car weighs 1.5 tons empty and 5 tons loaded, making a total weight of the loaded train of 10 tons. On a level the cars run at a speed of 15½ miles an hour. The controller used is small and like that of ordinary trolley cars. The passenger cars will seat 26 persons. It is stated that the cost of construction is about 25,000 marks per kilometer.

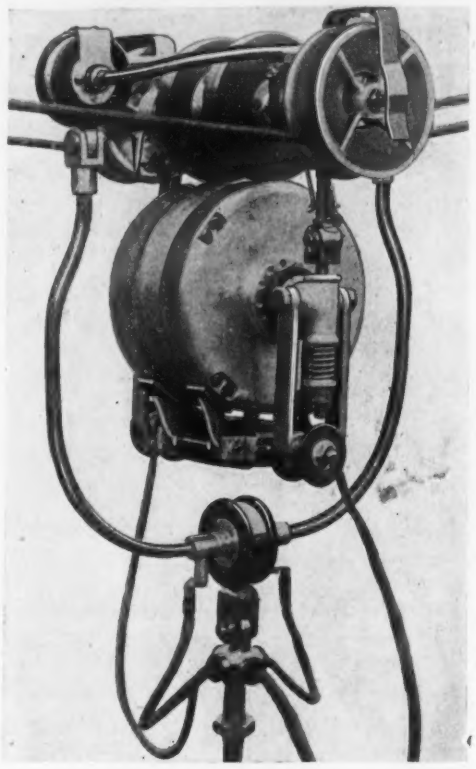
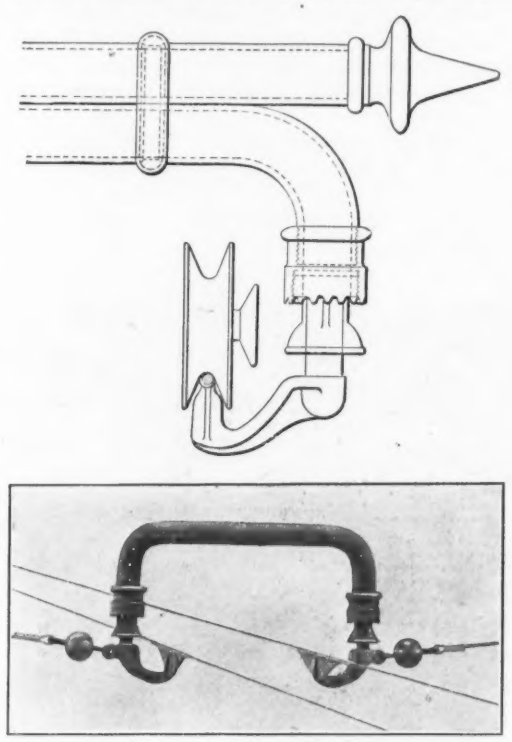


FIG. 3.—LOMBARD-GERIN CURRENT COLLECTOR.

The Lombard-Gerin system has already been noted in these pages, having been brought to attention at the time of the Paris Exposition of 1900, where it was shown. Since then it has been installed from Fontainbleau to Samois, about 5 kilometres, while



FIGS. 3A AND 3B.—DETAILS OF METHODS OF SUSPENDING TROLLEY WIRES.

another and longer line is now being developed along the famous Corniche road in Southern France, from Nice to Monte Carlo. As already stated in these pages, [1] the Lombard-Gerin system has an "auto-trolley" attachment, Fig. 3, which consists of a small three-

[1] ELECTRICAL WORLD AND ENGINEER, Vol. 35, No. 10. March 10, 1900.

phase motor suspended between the two conducting trolley wires, which are set 12 inches apart. The motor is hung in a frame which also carries two trolley wheels. The motor has a revolving field which communicates motion to the trolley wheels. It is of the three-phase type, current being fed to it from the motor of the troller is in the usual place on the front platform and there are electrical and mechanical brakes. The trolley motor is so geared as to give it a speed a little in excess of that of the car itself, so as to lead the way, from which feature it has won the cognomen of the "blind man's dog."

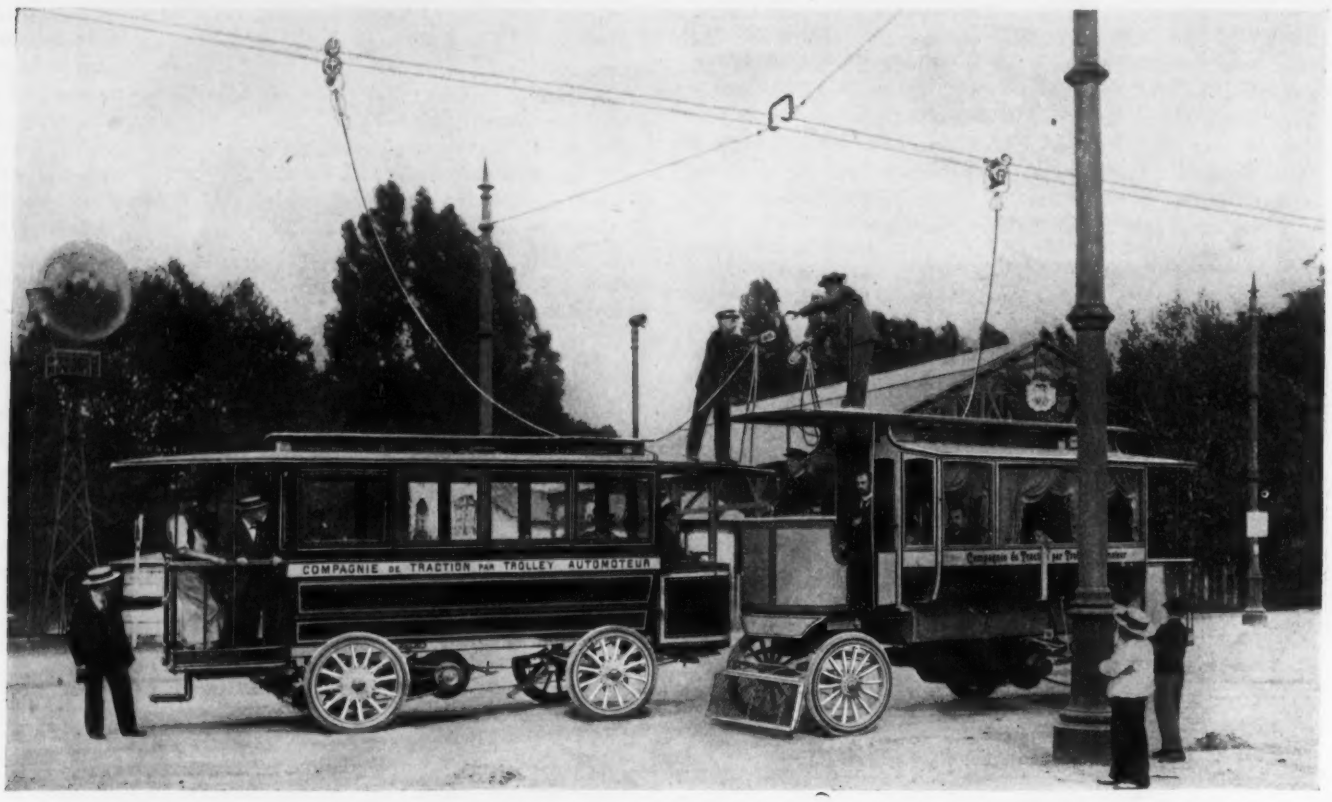


FIG. 4.—CHANGING CONNECTIONS WHILE PASSING.

omnibus, the latter motor being virtually a rotary transformer supplying the current for this specific purpose, besides being a direct-current motor. The armature of the series car motor has three rings, etc., connected to three points in the winding, and in

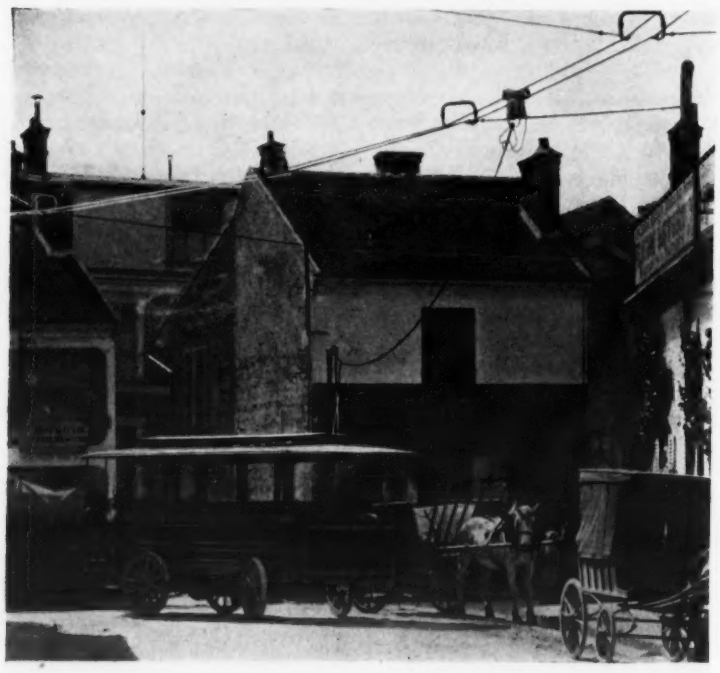


FIG. 5.—CURVE IN NARROW STREET, SAMOIS-FONTAINBLEAU LINE.

this manner the motor functions also as a three-phase generator of variable frequency. The motors are usually built of light cast-steel and resemble those for ordinary street car work. The con-

The time for the five kilometers between Samois and Fontainbleau, Figs. 4 and 5, is about 20 minutes, and there are now two omnibuses in service. The parent Compagnie De Traction par Trolley Automoteur, owning the system, gives the ratio of expenses to receipts as fifty-eight per cent., and quotes the expense of operation as follows: The electrical energy at 25 centimes per kw-hour amounts to 1,355 francs and 25 centimes, or .161 centimes per car kilometer. The repair expenses of the carriages are given as about 776 francs, or .092 centimes per car kilometer; and the working of the omnibuses, with one man per vehicle, is given as 456 francs, or .054 centimes per car kilometer, while the general expenses amount to 307 francs and 55 centimes, or .036 centimes per car kilometer. This makes a total expense of 2,895 francs, or .343 centimes per car kilometer.

For the line on the Corniche road, Mr. G. Sacco Albanese, of Nice, has obtained a 50-year franchise from the French government. This engineer will obtain current from the Mediterranean Power Company at Nice, at 10,000 volts, transformed at sub-stations at each end of the line and midway to 500-550 volts direct, for the bus motors. The line is to go into operation at the beginning of 1903 with 12 omnibuses each capable of carrying 12 passengers seated and 4 standing. Mr. Albanese estimates the cost of construction for the 20 kilometers of line, the 12 omnibuses, car shops, sub-stations and all accessories at $200,000. Ornamental iron poles are used within city limits and wooden poles outside. The grades along the road are quite heavy in places. A point of interest is that in order to pass and change trolleys, the conductor will not be obliged to mount on top of the car to effect the transfer, where there are no sidings or overhead switches. In the earlier arrangement, as at Fontainbleau, there is a pin contact at the lower end of the flexible cable, to permit of the exchange, but, as we understand it, the trolley standard is to be improved to obviate the awkwardness and delay arising from this cause. Early trolley systems in the United States, as on some of the Van Depoele roads, were accustomed thus to exchange their flexible cord trolleys in passing each other.

Independent Telephony in Buffalo.

BY JAMES MALCOLM.

THE independent telephone plant being constructed in Buffalo, N. Y., is being installed under the terms of a franchise dated December 13, 1901, which gives the Frontier Telephone Company the right to lay its conduits, and to place poles in all the streets, except the more prominent ones, a total of approximately 75 miles of street, where the company is permitted to set distributing poles in locations first approved by the Commissioner of Public Works. Stipulations are made as to the number of contracts that must be obtained within a certain time and the service rates are fixed. These are for unlimited service $48, $40, $36 and $24 for direct line, two, three and four-party business lines, respectively, and $36, $24, $20 and $15 for direct line, two, three and four-party residence service.

The other terms of the franchise of interest include a guaranty, protected by a bond, requiring the company to maintain competition with the Bell system during the life of its grant, and another guaranty, also protected by bond, insuring the proper repair of streets torn up. The grant expires after forty years from the date of its issue.

During the latter part of January of this year the plans were started for the necessary construction work. It was decided that an ultimate capacity for 30,000 lines was to be taken as the basis for calculations. The building site was located near the theoretical telephonic center of the city, care being taken to so locate this point that in a further development of the system it would not be necessary to install a second office in the business portion of the town. The property purchased for the central office installation is No. 332 Ellicott Street, between Mohawk and Huron streets. Here a building is now being erected to provide accommodation for an 18,000 line, straight multiple, common

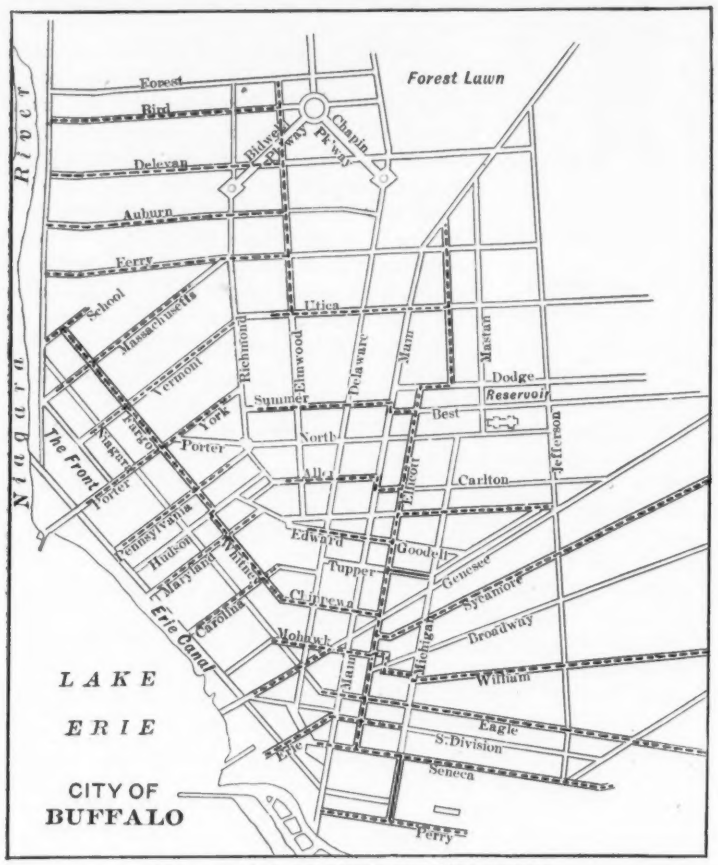


FIG. 1.—MAP SHOWING CONDUIT ROUTES.

battery installation. This building has a frontage of approximately 65 feet by a depth of 132 feet. It is three stories high, and is intended to serve the company's requirements for office room and supply storage. No more room is provided than the company will need for its own purposes, but for these purposes the space provided has been arranged for under a liberal estimate.

The main feature of the building is its switchboard room. The 18,000 line, multiple board above referred to, would require, if set up in one straight line, a room approximately 375 feet in length. Installed in the ordinary U or horseshoe shape, the length of the room required would be approximately 185 feet. Either of these dimensions would be manifestly difficult in a building of ordinary size, so it was decided to put the multiple on two separate floors. Each room, according to this scheme, is approximately 80 feet long by 46 feet wide. The lower one is on the second floor of the building, and the upper one, which

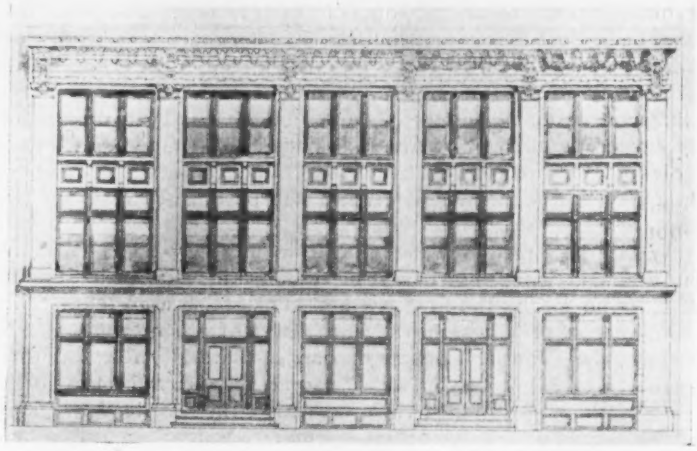


FIG. 2.—FRONT ELEVATION OF BUFFALO INDEPENDENT TELEPHONE EXCHANGE.

is a gallery above the lower, forms the third floor of the building. There will be a skylight in the roof of the building as large as the opening made by the gallery rail, which will light the front of the switchboard on both floors.

It will be noticed that this arrangement, while entailing a slight additional expense for multiple cables, effects so great a saving in the length of the answering jack cables, that it is really an economical plan. The power plant for charging the storage batteries, is in triplicate, two units being driven by motors and one by a Westinghouse gas engine. The underground cables are extended up through the building to a point just under the level of the distributing boards, in which they terminate in the customary standard manner.

The company's conduit system embraces a trench length of approximately 30 miles. The average number of ducts in each trench is approximately 6, or a total of very close to one million duct feet. It was decided that in all of the business district and the more important residence section of the city, the wires should be kept underground as much as possible. The map shown herewith covers that portion of the city in which conduit work is being done. To readers unfamiliar with the city of Buffalo it may be explained that the eastern city limits lie approximately two and one-half miles east of the easterly portion of this map, the northern city line is about three miles north of its upper side, and its southern line three miles south of the bottom of the map. All of this outlying district will be fed for the present by pole lines, but as any one district develops, it is to be entirely and thoroughly rebuilt with an underground system. At least 75 per cent of all the telephone subscribers in the city are located in the district shown by the map. The conduit line has been run as closely as possible along one side of each of the city blocks. In the downtown part of the city, lateral pipes are being laid from conduits directly into the building basements, where cables are to be terminated, so that no overhead work will be necessary. The office buildings are being thoroughly cabled to small terminals on each floor. Further out in town, where each house is surrounded by its yard, or, in other words, where it is impossible to run through the wall from one basement directly into the next, distributing poles are being placed in each block. In these cases the lateral pipe from the conduit is laid through adjoining private property to the distributing pole, so that wires are kept underground until they reach the back of the building and are actually ready for distribution to the subscriber. Experience in several of the largest telephone plants in the country has shown that up to a reasonable limit it is perfectly safe to install cables of 22 gauge wire, instead of the conference standard No. 19 gauge, which was orthodox in all the magneto plants built from 10 to 12 years ago.

The Buffalo system places a limit of 500 ohms circuit resist-

ance on each of its lines. This necessitates the use of No. 20 gauge conductors for reaching a few subscribers located in a zone close to the northern, eastern and southern city boundaries. The average line length in the Buffalo plant will be approximately 5,000 feet, which makes the average line resistance considerably less than half of 500 ohms. The use of small gauge conductors carries with it the possibility of using a large cable unit. The Buffalo unit is 400 pairs. This effects an important economy in the number of ducts in each trench. The poles that are being used for distribution purposes are practically all Idaho cedar, which, to those initiated in the craft, is the standard for symmetry of shape and soundness of timber. The conduit work, which was started early in May, has been very rapidly executed, and will be finished around this time. Most of the poles are in position. The underground cable work has been going on for some little time, and will be finished in about two months.

While the Frontier Telephone Company's system is the first independent work that has been actually undertaken in Buffalo, it is by no means the first attempt to establish a system. Since a number of previous efforts on the part of other people proved fiascos, the Frontier Company's officials naturally felt that their earnestness might be viewed with some skepticism by the public, so after having obtained their franchise, they made their plans, made contracts for all necessary materials and apparatus, and laid the main portions of their conduit system before putting a solicitor in the field. This action seems to have had the desired effect. Several hundred requests for telephone service were received before the company had prepared the necessary stationery on which to record such transactions. The first canvassers sent out met with a warm response to their solicitation, and each of them brought in from one to a dozen contracts per day. The number of contracts on file recently was a little over 3,500, which, by the way, is the number the city requires shall have been obtained before December 31, 1903. While the number of contracts actually obtained is reasonably large for the amount of time and labor expended in getting them, the canvassers' records show that a large number, possibly twice as many contracts as above noted, will be signed up as soon as the Frontier system is in actual operation. Another large number of subscribers will sign for service as soon as the contracts for their present telephones expire.

The Frontier Telephone Company confidently expects to be running in the new year with a subscribers' directory of 6,000 to 7,000 names, and at even a moderate increase, estimates that 10,000 lines will be working in the switchboard within one year from the inaugural date. The Bell Telephone Company, which has been in existence in Buffalo for about 20 years, and which has equipped its system with every form of switchboard from the primeval type to the present standard multiple, lamp signal installation of to-day, has from 10,000 to 12,000 subscribers in its list. It will be of interest to telephone people all over the country to know as time goes on how the service of the Bell Company, with its high grade, small unit central exchange system, will compare with that of the equally high grade, larg unit, single station system of the Frontier Telephone Company, equipped by the Kellogg people, with the plant already noted in your columns.

The officers of the company are: President, E. C. Lufkin; vice-president, John B. Weber; secretary and treasurer, Chas. B. Hill; general manager, Samuel E. Wayland; superintendent, Willbur H. Johnston.

The directors are as follows: Irving A. Stearns, Henry H. Persons, John B. Weber, H. D. Kirkover, Alvan Markle, E. C. Lufkin, Arthur Scranton, Charles B. Hill, William A. Douglas, James M. Thomas, Charles E. Austin, Martin Carey, Fred R. Green and Charles W. Goodyear.

Municipal Street Railways.

A movement toward the municipal ownership of street railways has been defeated at a special election held at San Francisco. A proposition to issue $700,000 of bonds for the purpose of equipping and operating the Geary Street Railroad was beaten by a vote of 15,120 to 11,334. A two-thirds majority was necessary to carry the measure.

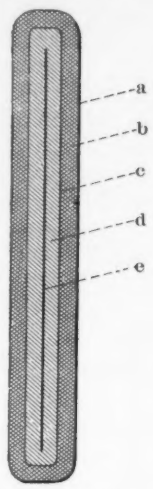
Self-Forming Separator in a Nickel Peroxide Storage Cell.

BY A. L. MARSH.

A NICKEL peroxide storage cell has the property of forming its own separator. A small cell was made as follows: The neck was cut from a glass bottle so as to form a containing vessel about 2½ inches long, 1 inch wide and 3 inches deep. A piece of nickel gauze was bent into shape to fit around the inside of the cell.

Next, a negative plate of spongy cadmium was prepared. A thin strip of sheet iron (about 2 x 2½ inches) was perforated from both sides, so as to form projections which would retain the spongy cadmium until fixed in the cell. The cadmium was prepared by electrolyzing with a strong current, a solution of cadmium sulphate, using a stick of cadmium for the anode and a platinum wire for the cathode. The cadmium deposited rapidly in a spongy condition, and was from time to time scraped off and thoroughly washed. This spongy metal was pressed on both sides of the iron plate, thus forming a porous cadmium electrode with a conducting core of iron.

Sesquioxide of nickel (Ni_2O_3) was next prepared. A solution of nickel sulphate was precipitated with caustic potash, and an excess of this reagent added. Nickel hydroxide (No $(OH)_2$) is the precipitate. Bromide was then added in sufficient quantity to change all the green hydroxide to the black hydroxide $Ni_2(OH)_6$. (Chloine, being cheaper, is generally used in place of bromine.) This black hydroxide was filtered off, well washed and then allowed to air dry.



SELE-FORMING SEPARATOR.

To construct the cell the nickel gauze is first inserted. Next the cadmium electrode is placed in the center of the cell and held away from the nickel by small pieces of rubber. The dried but still hydrated sesquioxide of nickel is then packed between the two electrodes and a sufficient amount used to cover them. A copper wire is soldered to each electrode, both the solder and the wire being coated with asphalt paint to protect them from the electrolyte.

A rubber cover was provided for the cell to protect the alkaline hydroxide electrolyte from the action of the carbon dioxide of the air. The cover was provided with a valve for the escape of gas. A twenty per cent solution of potassium hydroxide was then poured into the cell until the materials were thoroughly saturated with the liquid and covered to a depth of about one-eighth inch. The wetting of the nickel oxide causes it to swell and exert a pressure which insures good contact with the electrodes.

In a short time a thin layer of the nickelic oxide (Ni_2O_3), in contact with the cadmium, becomes reduced to the green oxide (NiO) and forms a good separator. The oxide (NiO) being of a flocculent nature and the layer thin, this separator offers only a slight resistance to the electric current.

Perhaps a better form of the cell would be to have the peroxide of nickel electrode surrounded by the spongy cadmium. For a commercial cell cadmium is said to be not a sufficiently abundant metal to use as the negative. Iron is at present the preferred metal for this purpose. The nickel-iron cell has been pretty well covered with patents, but so far as I know the construction to be described below is new.

Since nickel peroxide is of such a nature that it is apt to fall away from the grid unless held in place, this electrode should occupy the middle of the cell and be surrounded by the negative spongy material, which is porous enough to allow the interior portions to keep moist and conductive, and at the same time retains the peroxide powder.

The peroxide plate is then prepared by any method found to be suitable, and in such a way that the nickel grid is entirely covered by a peroxide layer of uniform thickness. This

electrode is then surrounded by a layer of spongy iron or a compound reducible to spongy iron. The whole is surrounded by a perforated envelope which serves as the negative grid or conducting plate and is perforated to give the electrolyte access to the interior of the couple, and to provide for the escape of gas.

The positive and negative grids should be held apart by suitable insulating material to prevent the possibility of shifting of the active materials and the consequent short-circuiting of the cell. The top should be closed by a suitable cement. In the accompanying illustration, *a* is a perforated iron envelope; *b*, spongy iron active material; *c*, insulating layer of nickel oxide (NiO); *d*, nickel peroxide active material; *e*, positive grid of sheet nickel.

This couple would form a unit. A cell of any desired capacity could be obtained by choosing the proper number of couples for each cell. The containing vessel or cell could be made of sheet iron or steel, since the electrolyte would be a 20 per cent solution of potassium hydroxide.

Such a cell would use the least possible quantity of electrolyte, would be strong and compact, and would be easy to repair, since the couples would be easily accessible, could be separately tested and any faulty one readily replaced.

A cell of the above construction would offer the objection that overcharging would tend to dry out the interior portions of the active materials by the decomposition of water. Notwithstanding this drawback, the cell ought to be well adapted to work where dry cells find a use.

Since in the strong cell described, there is nothing added to, or taken from, the electrolyte as a whole, and since it can be recharged when exhausted, this cell ought to have a considerable advantage over the dry cells in present use.

Water Vapor.

BY ALFRED G. DELL.

THE following contains some observations made in experimenting with rotating disks, which, we think, suggest a valuable application of the same. While it does not pertain directly to electricity, it would, I think, be of value in its applications to delicate instruments used in measuring electricity.

I have found that when the humidity has been reduced in the boxes containing rotating disks, as formerly described, the disks greatly improve in their rotations; in other words, they rotate on using the blowers, as formerly described, with greater velocities and with less forced air from the blowers than when the humidity is higher.

It appeared that moisture collects about the points of the disks and the jeweled bearings, and to a considerable extent retards the velocities of the disks. It seems that any substance in the ordinary humidity of the air is covered with a film of moisture, although it is not readily detected. The following is an application:

Suppose such parts of a measuring instrument as the needles of sensitive galvanometers were inclosed in boxes from which the moisture had been removed; they would to a certainty not only be more constant, but far more sensitive than those exposed to the humidity of the air. While such instruments are generally in boxes, they are not moisture proof, as they must be perfectly sealed up after the moisture has been removed to be so.

The boxes could be placed open in larger air tight vessels with chloride of calcium or some other absorbent, and left there for several weeks, in a warm place if chloride of calcium was used. The covers of the small boxes, or small holes with plugs to fit, could be arranged so they could be closed while in the larger boxes, and then removed and quickly sealed. A high temperature removes the vapor, but I have found it not as effective as an absorbent, and besides the heat might injure the instruments. Such instruments could easily be made air tight, as glass and metal are generally used in their construction. I do not believe all the water vapor can be removed by any known means, but it can be reduced to a minimum.

Electrochemistry in Lithography.

BY E. C. HANDY.

TO the average reader, lithograph is associated with the printing of gaudy, many-colored posters which are everywhere seen about our great cities; and but few people realize that in order to obtain these most conspicuous heralds of business, a process is gone through which requires exceedingly delicate manipulation. Bill posters and lithographs, as all printers know, are usually composed of many colors of ink, and each color of this ink is printed or impressed upon the paper at separate and individual times, making, therefore, a most expensive process when good work is done, as the paper has to be reprinted many times before it is ready for the customer. Much money and inventive thought have been spent upon methods to reduce the cost of this work, and recently an electrical process for this purpose has been devised.

The first process of lithography is to transfer the "work" or "picture," which has been drawn by the artist upon a species of limestone especially prepared for that purpose, upon a chemically prepared paper which exactly duplicates the original work. These papers can be kept for some time. It then becomes necessary to place the work which rests upon this paper upon a base for printing. The old method was to transfer it upon a flat stone whose surface is hardened, and later etched away so as to allow printing. By this method each individual color, or portion of the whole, has to be put upon different stones—a tedious and costly process.

It has long been known that certain metals, such as zinc and aluminum, can be prepared so as to give a certain surface capable of holding an "image" or "transfer." In many shops zinc is used in sheets reinforced by being strapped to an iron base, and in others aluminum is used. The zinc being more generally known, will be dealt with here.

Ordinary zinc surface is, when polished, smooth as glass, and wholly unfitted for printing; for although it will admit of a transferring of the work, and will hold the ink, it smudges at the very first application of the paper in the press. It has, therefore, been found necessary to especially prepare this surface by roughening it to a certain degree. This roughening is successfully done by exposing the polished surface to the action of a fine, hard, silicious sand or emery upon which marbles are rolled by eccentric agitation for some time. This surface, however, was not found to be as desirable as limestone, and has never superseded it to any extent.

A few years ago a chemist and lithographer discovered that if a copper sheet be plated with a coating of zinc by electrolysis, a beautiful grain or surface suitable for printing could be obtained; but although the discovery was patented it took a long series of experiments to adapt it to the work from a commercial standpoint. In the first place, the "grain" was not smooth and equal throughout, and it was found that this was due to the copper surface not being properly polished. Again a long series of experiments had to be carried through to determine what form of electrolytie and what current density and what gap distance should be used to obtain good results. Finally, a good uniform coating was secured and successfully applied. About this time it occurred to the experimenters that if the coatings were made upon round tubes and a special machine or press constructed, the whole process of printing could be gone through at one operation. This process is now in operation and is being continually improved.

Revolving copper tubes are coated with zinc, transferred upon for different colors, and if the whole process is successfully carried out many thousands of impressions can be secured in one operation of the "multi-press." The copper tubes must be of an extra quality of metal ground to a dimeter of great exactness, and the entire surface must be smooth and free from flaws. These tubes are coated in about one-half hour with a bright granular coating of zinc, which must be cleaned and dried with great care, as even a touch of the finger or a heavy damp breath upon the surface may condemn it for use, as it will take up the oil from the finger, and will be tarnished or etched by the carbonic acid in the breath.

These tubes are then transferred upon and assembled in the press, until they cease to print longer without smudging. They are then returned to the plating department, where they are cleaned with turpentine and then immersed in a bath of dilute zinc chloride, the tube being connected into the circuit as anode, and a discarded anode from another bath utilized as a cathode, which is gradually replenished and

built up (to be reused). As soon as the color turns black, the circuit is broken and the tube removed, cleaned and polished with very dilute nitric acid and chalk or pumice powder. It is then ready to be reused and replated for another operation, and if properly handled can be used daily for a year or more. By this method there is but little loss of material. The principal one is the turpentine which is used to remove the ink, and it has been proposed to put the tube as it comes from the press into a very deep tank. On passing current most of the ink matter will separate, some floating and some sinking; that which floats turpentine can be skimmed off and used again. One great task is to keep the zinc baths free from grease, and neutral; grease spoils the surface for transfer and an alkaline or acid bath seems to affect the surface by etching it, to some extent shortening its life in the press.

This zinc surface being soft, is quite rapidly worn away and other metals have frequently been experimented with, among them aluminum, iron, cobalt, nickel and copper. As yet zinc stands in the first rank as a most useful agent to the lithographer when coated over copper with skillful manipulation by aid of electricity.

The Armature Reaction of Alternators—VI.

By C. F. Guilbert.

PREDETERMINATION OF LOAD CHARACTERISTICS.

THE diagrams which have been published having for their purpose to facilitate the predetermination of load characteristics by graphic methods, may be divided into two classes:

The first class comprise those which involve only the e.m.fs or the flux which they produce. The earliest of this class is the Kapp characteristic, and it comprises those of Behn-Eschenburg and Blondel, as well as the more recent ones of E. Arnold and Picou.

The second class are those which involve only the ampere-turns, and is confined to the well-known characteristic of E. Arnold with its modification, which latter takes into consideration the increase of field magnetic leakage with load.

The third class is much more numerous and comprises the characteristics which involve not only the e.m.fs and flux, but also the ampere-turns. This class comprises the diagrams of Rothert, Heyland, Potier, Niethammer, the more recent one of Bauch and that of myself.

As we have stated at the beginning of this article, our intention is not to discuss the merits and faults of each of the characteristics that we have named. We shall merely enter into the subject far enough to arrive at two characteristics sufficiently exact for practice, one entirely general and the other applicable to alternators with non-saturated armatures, which type is most numerous. We shall not take up the characteristics of Behn-Eschenburg and Arnold, upon which judgment was long ago passed, and which are of little practical use except in the case of alternators having an induction so low in their metallic magnetic circuits that it can be considered as proportional to the m.m.fs which produce it.

CHARACTERISTICS OF THE FIRST CLASS.

These characteristics are generally exact, especially when they take account of the difference of effect of the transverse and direct reactions, as was proposed for the first time by Blondel. The characteristic of Picou, which is none other than that of Blondel with slight modifications taking account of the increase of field magnetic leakage and giving a new determination of distortions, appears to us to be the most exact, and criticism can only be directed at the means proposed for the determination of the value of the flux due to the transverse m.m.f., as well as the reduction of the useful flux resulting from distortion.

The effect of the distortion of the field is, as is well known, to diminish the induction under one pole horn and to increase it under the other. If we consider the tubes of force from the field into the armature, those which pass through the most saturated part of the gap require a supplementary excitation, while those which pass the least saturated portion require on the contrary a diminution of ampere-turns. If the number of supplementary ampere-turns is equal to the decreased ampere-turns, the mean excitation ampere-turns remain the same, and the increase at one side of the axis of a field pole and the diminution at the other side is then obtained through the transverse m.m.f. If, on the contrary, the increased ampere-turns are less in value than those of the decreased ampere-turns owing to diminution of the permeability with increase of induction, the mean excitation should be increased to maintain the same mean flux; or if the excitation remains the same, the mean flux should be diminished. To calculate this reduction of the mean flux it is evidently necessary to make two hypotheses, one on the distribution of the transverse m.m.f. along the polar face, and the other on the distribution of the induction at the interior of the metallic part of the field magnetic circuit.

Picou adopts for the transverse m.m.f. a linear distribution; that is to say, increasing and decreasing proportionally to the distance from the middle of the pole. This rule, which is rigorous for direct-current machines, is not so for alternators, in which case we have to deal with a sinusoidal variation. It is this law of distribution which we shall adopt, though the method to be given for the determination of the transverse flux can easily be generalized.

As concerns distribution of induction in the different sections of the field magnetic circuit, Picou assumes that the distribution remains similar to that in the gap at all points of the field magnetic circuit. This amounts to saying that the distortion extends along the entire magnetic circuit. This hypothesis is evidently not well founded, for there is no doubt that the induction tends to become homogeneous in each cross section of the magnetic circuit according as the distance of these sections from the gap increases. It can thus lead only to an approximate result which becomes less exact as the field is more saturated. It seems to us that we come nearer to the truth by admitting that the induction becomes homogeneous upon its entry into the pole core, or otherwise stated, that the distortion need be considered only with relation to the pole faces. While the hypothesis of Picou leads to values too high, the substitute proposed has an opposite effect.

With this hypothesis it will suffice to apply a construction of the same kind as that of Picou, but not, however, to the curve representing the useful no-load flux load in function only of the field ampere turns, but to the armature characteristic; that is to say, to the curve representing the useful flux in function only of the ampere-turns necessary to cause this flux to traverse the armature, the gap and the parts of the pole piece traversed by the useful flux.

The separation of the armature characteristic from the useful flux characteristic at no-load, or rather the division of these last into two curves, one referring to the armature and the other to the field, and each in function of the m.m.fs necessary to these parts of the magnetic circuit, has been suggested to us by Potier. We have made considerable use of this method in this article, as will be seen later. In the following article the construction will be given to which the above remarks refer.

The Penalty of Fame.

The subjoined, from the *New York Journal*, is extraordinary, anyhow, and shows how the "people" note what is taking place: Since Judge Warren W. Foster imposed a fine of $100 on Nikola Tesla, the electrical inventor, for failing to obey a jury notice, the Judge has received a number of eccentric letters from Mrs. Annie Thierstein, of No. 239 East Fifty-fourth Street. One, which he received recently, was registered to insure its reaching the Judge. It reads as follows: "I must remind again you, Mr. Judge, as to Nikola Tesla, the electrician. He used me as a living telephone for his revolving motion, already since four years, causing ruin to my existence and good reputation. I lose all the parties for whom I do laundry work because the fine people of the West Side complain of the nuisance deriving from the telephonograph. Tesla knows all about the damage done by him for four years. He must give compensation for it, and cannot deny charge as I have witnesses. I desire, Mr. Judge, you would call us both officially as soon as possible. I already sent you three times to assist me. I am not bound to take my own life for want of work and means. Tesla drives me to despair. He is an unscrupulous fellow. He, unconcerned, looks on at his living telephone as it wastes away in misery. I trust, Judge, you won't forget calling Tesla to task." Judge Foster says he does not know exactly what he will do with this "human telephone," but declared his secretary would probably attend to the matter.

Wire and Cable Specifications.

By L. T. COLLINS.

THAT manufacturers of electrical wires and cables are often asked to bid on specifications unreasonable and sometimes absurd, is a fact so well known as scarcely to excite comment. As an instance of this, one of the largest manufacturers of electrical machinery in the world, recently sent out specifications on No. 12 B. & S. cables and smaller, with walls of rubber varying from 2 thirty-seconds to 3 sixty-fourths on which they required a test of 6,000 volts for thirty minutes and 9,000 for thirty seconds under water. These wires were for 500-volt service. As an example of extreme requirements in the opposite direction, one of the large electric lighting companies specified a 12 thirty-second wall of thirty per cent. Para compound on a No. 5 B. & S. stranded cable for a working pressure of about 6,000 volts and a test of 15,000 volts.

The many points to be considered in determining the proper wall of insulation for a given pressure, make hard and fast rules impossible. The manufacturers of electric wires and cables have had the widest experience along these lines, and with full knowledge of the conditions of service, their judgment is of the greatest value. Many users of electric wires and cables have learned this fact, and invariably consult one or more well known manufacturers before drawing up specifications for cables to meet special conditions. The wisdom of this course is shown by the instances cited above. In one an excessive coefficient of safety makes the cable unnecessarily expensive, and gives the manufacturer who uses cheap compounds an unfair advantage. In the other, the coefficient of safety becomes a negative quantity, and the manufacturer must either refuse an order given under such specifications, or ignore them. In the latter case the risk is run of having the goods returned and general dissatisfaction and ill-feeling result.

While writing on this subject, it may be well to call the attention of purchasers of electric wires and cables to the fact, that however carefully they may draw specifications as to the percentage of Para required in the compound to be used, they are in a great measure dependent upon the honesty of the manufacturer. An inferior compound can be made to give a high initial test. The general appearance and elasticity of the compound indicates only in a measure the quantity and quality of the rubber used, and the ash test, while determining the quantity of organic matter, does not show the quality of the rubber, merely the percentage. The consumer has to depend upon the honesty of the manufacturer, who often sees contracts awarded at little more than the cost of materials if the specifications were strictly complied with. For instance, the navy specifications call for a forty per cent. Para compound. but the manufacturer whose figures are based on furnishing such a compound would be sadly left. In awarding contracts the reputation of the manufacturer for turning out good work—a reputation only acquired by years of honest effort—is seldom given proper consideration.

The acme of absurdity seems to have been reached in some of the rules of the National Board of Fire Underwriters. As these rules have a wide influence and are often embodied in specifications, a brief review of the ones specially referred to may help towards a sensible revision.

Beginning with Class D, Section 41, paragraph C, one finds this covers the insulation resistance for National Code wires and cables to be used at not over 600 volts. These are for interior work and are not supposed to be subjected to moisture, except such as may be in the air. Against sudden excessive moisture they are amply protected, as such a condition should be temporary. This rule calls for an insulation resistance of 100 megs. per mile, a reasonable and safe requirement. The test, however, is to be made, *"during thirty days' immersion in water at seventy degrees Fahrenheit."* Clearly, this means submersion for thirty days.

Ignoring the evident absurdity of submitting wires and cables for interior use to thirty days' submersion, while most marine cores receive a final test at the factory after forty-eight hours under water, let us consider some of the difficulties the manufacturers would have to overcome, if this rule was complied with.

There is probably not a factory in this country that has a fraction of the tanking capacity necessary to meet this requirement; to build the tanks would mean a useless outlay of thousands of dollars. Having built the tanks, however, the next step would involve locking up capital in stock, as a thirty days' supply would have to be carried. Assume these difficulties have been overcome and the problem solved of approximating (no exact figures could be made) the demand for the next thirty days, the manufacturer would be confronted with another difficulty. The demand for many sizes of National Code goods is so great, that it is almost impossible to accumulate a large stock of them. Again assume these difficulties have been overcome. Several large and unexpected orders arrive. The stock that has been in soak for thirty days is exhausted. Then a good customer sends in a rush order. Consider the painful position of the manufacturer. He must either refuse the order or offend his conscience by sending his customer stock unregenerated by having had only 28 or 29 days' baptism. Those who know the tenderness of manufacturers' consciences will realize the cruelty of this position. It is difficult to treat such a rule seriously, and one cannot escape the suspicion that it was never intended to be so treated.

If a more liberal interpretation is given to this rule, and one assumes that the intent is to submerge the wires and cables *from time to time* during a period of thirty days, it is no less absurd and almost as difficult to obey.

The above remarks are applicable to the rule regarding fixture wire (46 a) which having only one thirty-second wall of insulation, including braid, is allowed to escape after a seven days' soak.

Now as to pressure test (41 d) we find these wires and cables, which are to be used at not over 600 volts, are required to resist. *"Three thousand volts per one sixty-fourth of an inch thickness of insulation."* This test must be made after 72 hours' immersion (41 d, paragraph 2). Assuming that insulation means only the rubber, the pressure would be as follows:

No. 18 B. & S.	to 16 B. & S.	inclusive	1-32	wall— 6,000 volts.
No. 14 B. & S.	to 8 B. & S.	inclusive	3-64	wall— 9,000 volts.
No. 7 B. & S.	to 2 B. & S.	inclusive	2-32	wall—12,000 volts.
No. 1 B. & S.	to 0000 B. & S.	inclusive	5-64	wall—15,000 volts.
No. 4-0 B. & S.	to 500,000 c.m.	inclusive	3-32	wall—18,000 volts.
No. 500,000 c.m.	to 100,000 c.m.	inclusive	7-64	wall—21,000 volts.
		Over 100,000 c.m.	4-32	wall—24,000 volts.

The impossibility of meeting these tests must be evident to any one familiar, in a practical way, with the manufacture and testing of electric wires and cables. One might as reasonably expect to force a quart of water into a pint measure without something giving away. The same test is applied to wires and cables for voltage between 600 and 3,500 (41 f) viz.: 3,000 volts for every one sixty-fourth wall of insulation.

The only apparent reason for issuing such rules is, that it was thought by requiring a great deal, more would be secured than if less were required. This reasoning is fallacious. Rules that are impossible to obey cannot be enforced, and the condition is the same as if no rules existed. The consequence is that manufacturers of high-grade wires and cables are forced into unjust competition with cheaply made goods, and the blame for losses due to defective insulation falls upon all. Rules like these and specifications that are equally unreasonable, defeat the very object for which they are issued. Why should not so influential a body as the Board of Fire Underwriters set a good example by revising these rules in such a manner that while ample protection is assured, nothing unreasonable is required? Such rules could be enforced, if not fully, at least to such an extent as to make it unprofitable to risk using low-grade compounds. This would mean raising the standard of insulation and reduction of losses to all users of electric wires and cables. If such a condition were brought about, the Fire Insurance companies would be the greatest gainers.

Another Niagara Power Project.

Our Canadian correspondent states that it is proposed to erect another new electric power plant at Niagara Falls. William MacKenzie, president of the Toronto Electric Railway, and Fred. Nichols, president of the Canadian General Electric Company, are at the head of a syndicate which is applying to the Niagara Falls Park Commissioners for leave to set up a power plant at the Canadian Falls. The syndicate wishes a site between the two present power companies, the Canadian Niagara Falls Power Company and the Ontario Power Company.

Electrochemical Oscillations.

BY WOOLSEY MCA. JOHNSON.

ELECTROLYSIS by alternating currents has been known for some time. It is due to the irreversibility of the electrochemical system and is greater as the current density and time of oscillation increase. Quite in accordance with the facts known about alternating current electrolysis is the fact that with long unequal oscillations, the discharge curve reproduces the charging curve, and that depolarization current flows first in one direction, then reverses, flowing in the opposite direction.

This fact I discovered about a year ago while experimenting on the question of anode scrap as affected by resistance of alloys present in anode. Results of this investigation were given in a paper read at the Niagara Falls meeting of the American Electrochemical Society.

In this case I had a matte anode, an Acheson graphite cathode and a concentrated NaCl solution as electrolyte. Accidentally the circuit was closed so that the anode was cathode. As soon as the mistake was noticed, the current was changed, and when the voltage reached usual figure of 3.2 volts, the circuit was then broken and the usual depolarization curve taken. In this case, the voltmeter reading fell to 1.5 volts, then to zero and finally reversed until it gave a negative reading of 0.25 volt. This I thought showed that the films of caustic and acid imposed on electrodes, both of which were porous, caused the oscillations. It is analogous to the phenomenon described on page 144, Barker's "Physics"; "If a wire be kept twisted 90° to the right for six hours and then 90° to left for one

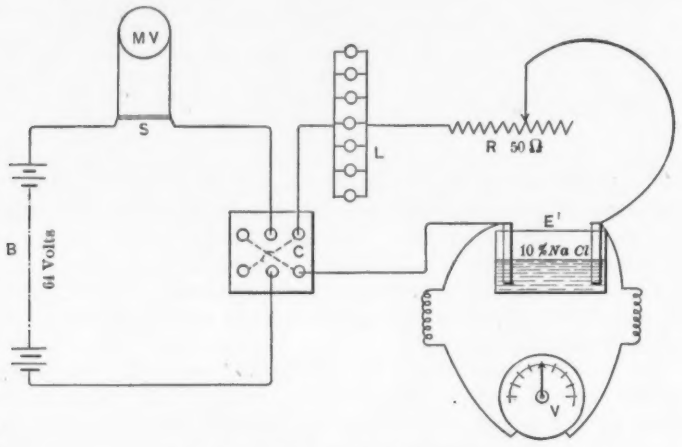


FIG. 1.—DIAGRAM OF CONNECTIONS.

hour, being allowed gradually to come to rest without oscillation, it will first turn slowly to the right, undoing the effect of the first twist, and then more slowly to the left, undoing the effect of the earlier twist."

In the past month, I have spent some time in studying this effect of "electrochemical oscillations." The apparatus is illustrated diagrammatically in Fig. 1. The source of current was a battery *B*, or 32 "chloride" cells of 120 ampere-hour capacity. The current was measured by a Weston shunt, *S*, and millivoltmeter, *M V*. The current was reversed by a commutator, *C*. A bank of lamps, *L*, and rheostat, *R*, enabled the current to be kept at a constant value, as the polarization voltage of the electrolytic cell was small as compared with the voltage of *B*. *V* was a dead-beat 3-volt, 135-ohm voltmeter made by Hartmann & Braun, which was quite convenient for taking depolarization curve as it read 3 volts right or left of the zero point. The electrodes were of 1.5-inch round Acheson graphite. The current density of all curves shown in connection with this paper was 10 amperes per square foot.

The method of procedure was first to short-circuit *E* until on open circuit no reading was seen on the voltmeter. The current was then passed for 40 seconds in one direction and then reversed. On breaking the circuit the reading of *V* was taken every five seconds at first and later every 20 seconds. As remarked above, the current was constant because the voltage of *B* was high in comparison with polarization-voltage of *E*.

If the time of reversal-current is less than 22.5 seconds, the depolarization curve shows the reversal of the current. (See Fig. 3.) That is, the current first flows in one direction, undoing the effect of the second polarization, and then reverses, undoing the effect of the first polarization.

When the time of the first polarization is 40 seconds and the second 20, this reversal took place at 7 seconds after breaking circuit. When the time of the first was 40 seconds and the time of second 15 seconds, the reversal came in 3 seconds.

When the time of first reversal was 40 seconds and the time of the second was 22.5 seconds, there was no reversal, but the current sank

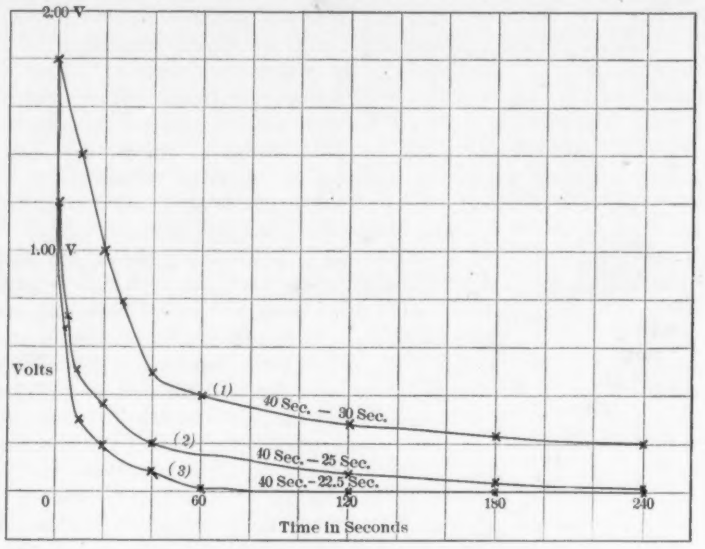


FIG. 2.—ELECTROCHEMICAL OSCILLATIONS.

gradually to zero. Curves 1, 2 and 3 of Fig. 2 show the effect of time of second polarization on the depolarization curve. Curves 4 and 5 of Fig. 3 show the oscillation from 1.5 volts to — 0.43 volt when the period of second polarization is short.

The oscillations depend quite largely on the nature of the electrodes. With metallic or non-porous electrodes, there is no such effect observed at low current densities. The greater the irreversibility of the electrochemical system, the greater is the tendency to oscillate on discharge. With metallic electrodes in an electrolyte of zinc sulphate and copper sulphate, at high current densities such an effect might be observed. The current density should be such that there is gasing at the anode but little at the cathode. We would then have "asymmetric action."

In the case of porous electrodes, there is imposed on the electrodes films of occluded gases. At the anode, for instance, there is chlorine in acid solution, in the pores of the electrode. When this is changed to the cathode, hydrogen in alkaline solution is formed first

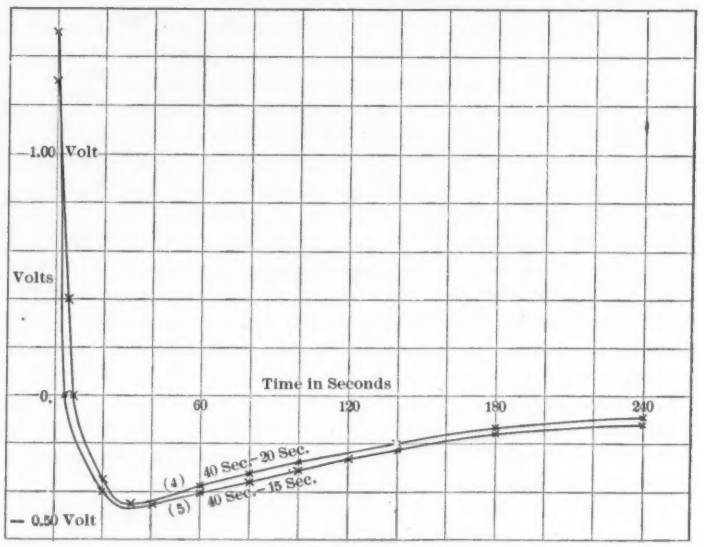


FIG. 3.—ELECTROCHEMICAL OSCILLATIONS.

in that part of electrode, "electrically near" the copper leading wire, while "electrically remote," the chlorine in acid solution still exists. Between these two there exists local action, but the speed is not as fast as speed of depolarizing action, consequently, when the hydrogen is used up with the formation of HCl, there still remains some Cl in the acid solution in the outer pores of electrode. This is a very

weak solution and has therefore a low voltage. A corresponding action takes place at other electrode, and the voltage of reversal is only 0.43 volt. This appears to be the only explanation of the above facts that satisfies the experimental conditions.

In conclusion, I would like to express my thanks to Prof. Henry A. Perkins, of Trinity College, who allowed me the privileges of the Jarvis Physical Laboratory for this and other work.

Three-Phase Measurements.

By A. S. McAllister.

THE term "power factor," as applied to alternating-current phenomena, is variously defined as the "ratio of electric power in watts to volt amperes," as the "ratio of true to apparent power," as the "cosine of the time angle between the current and the e. m. f.," etc. In single-phase and in independent two-phase circuits or in any symmetrical and balanced polyphase circuit these terms are synonymous, but in interconnected polyphase circuits carrying unbalanced loads the power factor will have practically as many different values as there are terms by which it can be determined.

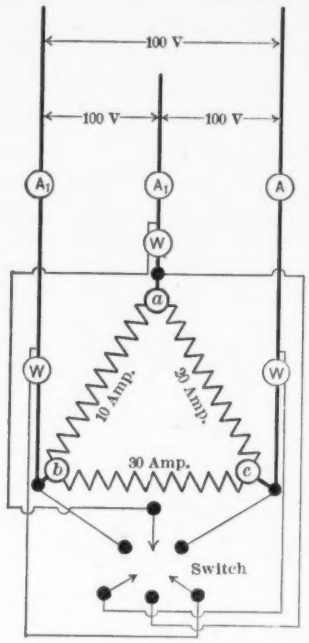


FIG. 1.—TESTING CIRCUITS.

Perhaps the most familiar example of circuits in which such discrepancies in results are found is the three-phase circuit operating on unbalanced loads. An exaggerated case of this kind, selected so as to emphasize the facts just stated, is shown below. In order that all disturbing influences, other than the unbalance of the load alone, may be eliminated from the problem, there has been assumed a non-inductive load supplied from a three-phase circuit having equal e.m.fs between leads.

Fig. 1 represents the circuits and load, and shows the connection of instruments for determining the power factor. As seen, an e.m.f. of 100 volts between leads and a delta-connected non-inductive load of 10, 20 and 30 amperes, respectively, per phase have been chosen. The true power is evidently 6,000 watts, while the power factor per phase is unity.

Referring to Fig. 2, which represents the value and position of the current per phase of the load indicated by Fig. 1, the value of current registered upon an ammeter at *C* and its relative phase position may be ascertained by making use of the geometrical figure *cdfe*. From the construction it is seen that the current at *c* is represented in value and phase by the line *cf*.

In the triangle *cef*, the side *cf* is equal to

$$(\overline{ce}^2 + \overline{ef}^2 + 2\,\overline{ce}\,.\,\overline{ef}\cos 120^0)^{\frac{1}{2}}$$

or is equal to

$$(\overline{ce}^2 + \overline{ce}\;\overline{ef} + \overline{ef}^2)^{\frac{1}{2}} = \sqrt{1900} = 43.60 \text{ and}$$

$$\sin \phi c = \sin 120^0 \frac{\overline{eb}}{\overline{cf}} = .866 \frac{20.00}{43.60} = .3971$$

$$\phi c = 23^\circ\ 24'.$$

Similarly the current at *a* is

$$(10^2 + 10.20 + \overline{20}^2)^{\frac{1}{2}} = \sqrt{700} = 26.45 \text{ and}$$

$$\sin \phi a = .866 \frac{10.00}{26.45} = .3272$$

$$\phi a = 19^\circ\ 6'.$$

Current at *b* is

$$(10^2 + 10.30 + 30^2)^{\frac{1}{2}} = \sqrt{1300} = 36.05 \text{ and}$$

$$\sin \phi b = .866 \frac{10.00}{36.05} = .2402$$

$$\phi b = 13^\circ\ 54'.$$

It is convenient to adopt some method of designating at once each wattmeter and its connection in the circuit. Place, therefore, as subscript to the letter *W*, which is to represent the reading of each meter, the letters showing the points between which the voltage coil is connected, and place first that letter corresponding to the lead in which is the current coil of the wattmeter. Thus, *Wab* refers to wattmeter having its current coil in lead *a* and its voltage coil connected across between this lead and lead *b*.

Wattmeter *Wac* will record *Ia Eac Cos øac*, or

$$Wac = 26.45 \times 100 \times \cos 19^\circ\ 6' = 2{,}500.$$
$$Wab = 26.45 \times 100 \times \cos 40^\circ\ 54' = 2{,}000.$$
$$Wbc = 36.05 \times 100 \times \cos 13^\circ\ 54' = 3{,}500.$$
$$Wba = 36.05 \times 100 \times \cos 46^\circ\ 06' = 2{,}500.$$
$$Wcb = 43.60 \times 100 \times \cos 33^\circ\ 24' = 4{,}000.$$
$$Wca = 43.60 \times 100 \times \cos 36^\circ\ 36' = 3{,}500.$$

It is seen at once that the true value of watts is recorded in each case by the sum of the readings of any two wattmeters with their current coils in separate leads and their free pressure terminals connected to the third lead, thus $(Wac + Wbc) = (Wab + Wcb) = (Wba + Wca) = 6{,}000$, but that the true watts may not be indicated by one wattmeter which has its pressure coil free terminal transferred from first one and then the other remaining lead, thus

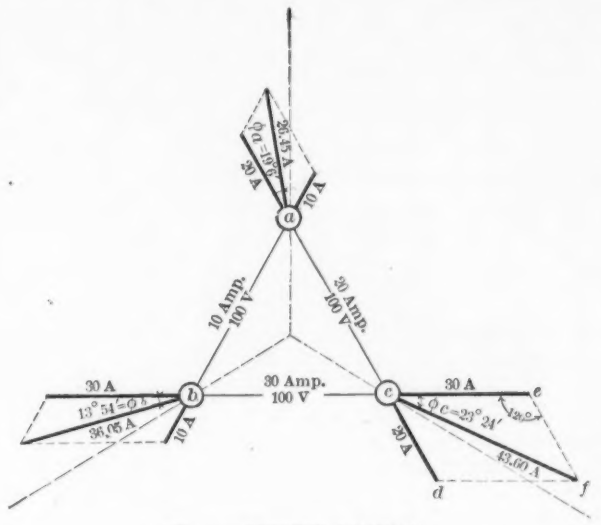


FIG. 2.—CURRENT DIAGRAM.

$(Wac + Wab) = 4{,}500$, $(Wbc + Wba) = 6{,}000$, $(Wcb + Wca) = 7{,}500$.

It has been advocated to determine the angle of lag and the power factor by the ratio of the readings of two wattmeters. That such a method does not give accurate results with unbalanced loads is well appreciated by all. For purpose of comparison, however, results determined by this method are here recorded:

$$\tan \theta = \sqrt{3}\,\frac{Wbc - Wac}{Wbc + Wac} = \sqrt{3}\,\frac{1000}{6000} = .2886$$
$$\theta = 16^\circ\ 6'$$
$$\cos \theta = .961$$

$$\tan \theta = \sqrt{3}\,\frac{Wcb - Wab}{Wcb + Wab} = \sqrt{3}\,\frac{2000}{6000} = .5772$$
$$\theta = 30^\circ\ 0'$$
$$\cos \theta = .866$$

$$\tan \theta = \sqrt{3}\,\frac{Wca - Wba}{Wca + Wba} = \sqrt{3}\,\frac{1000}{6000} = .2886$$
$$\theta = 16^\circ\ 6'$$
$$\cos \theta = .961$$

Since the load has been so selected as to be strictly non-inductive, it is evident that the lag angle indicated does not exist, and that the power factor obtained by this method is in error.

It is to be noted in this connection, however, that the angle of lag obtained by the same formula used above, but substituting the ratio of readings of one wattmeter when its pressure coil is transferred between the two leads, as mentioned above, has, in fact, a physical significance, as here shown:

$$\tan \theta_a = \sqrt{3}\,\frac{Wac - Wab}{Wac + Wab} = \sqrt{3}\,\frac{500}{4500} = 1925$$
$$\theta_a = 10^0\ 45'$$

An inspection of Fig. 2 will reveal the fact that this is the angle

between the current at *a* and the mean voltage between *ab* and *ac*, since $10° 54' = 30° - (19° + 6')$. Similarly,

$$tan\ \theta b = \sqrt{3}\ \frac{Wbc - Wba}{Wbc + Wba} = \sqrt{3}\ \frac{1000}{6000} = .2886$$

$$\theta b = 16°.\ 6' = 30° - (13°.\ 54')$$

and again,

$$tan\ \theta c = \sqrt{3}\ \frac{Wcb - Wca}{Wcb + Wca} = \sqrt{3}\ \frac{500}{7500} = .1155$$

$$\theta c = 6°\ 36' = 30° - (23°.\ 24')$$

A popular formula for determining the power factor of a three-phase load is

$$P.\ F. = \frac{W}{\sqrt{3}\ I\ E}$$

where I is the current per lead wire. Substituting the values found above for I, the power factor is

$$P.\ F.c = \frac{6000}{173.2 \times 43.60} = .795$$

$$P.\ F.b = \frac{6000}{173.2 \times 36.05} = .959$$

$$P.\ F.a = \frac{6000}{173.2 \times 26.45} = 1.309$$

$$P.\ F. = \frac{.795 + .959 + 1.309}{3} = 1.021$$

Using as a value for I the mean current per lead wire,

$$P.\ F. = \frac{6000}{173.2 \times 35.37} = .980$$

Several of the methods used above are obviously in great error, and their use would never be sanctioned in a careful test. Few objections, however, could be raised against the last two methods of averages, though neither gives the true result.

While as concerns the receiver, the power factor of the load is strictly unity, such cannot be considered true with reference to the transmission circuit.

Let R be the resistance of each line of the three-phase transmission circuit, then the copper loss in transmitting to the above receiver is

$$(36.05^2 + 43.60^2 + 26.45^2)\ R = 3{,}900\ R.$$

For a balanced load, 3,900 R watts would correspond to a load of $\sqrt{\frac{3900}{9}} = 20.81$ amperes per coil. Hence the effective, non-inductive "power factor" may be taken as

$$\frac{20}{20.81} = .961$$

In the determination of the power factor as the ratio of true to apparent power, the question arises as to what constitutes the apparent power, and the discrepancies in results are due to the various answers which may be given to this question.

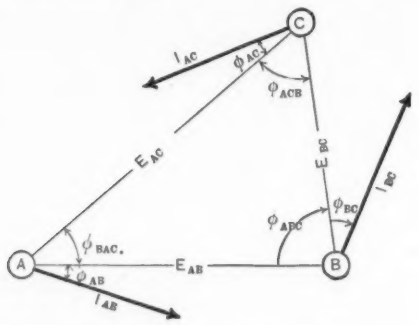


FIG. 3.—PHASE RELATION OF E.M.F. AND CURRENT.

While doubt must ever exist as to the value to be assigned to the apparent power in a three-phase system operating on an unbalanced load, the method in common use for determining the true power is correct for any condition of load, proportion of e. m. fs or relation of power factor of currents, though the methods of proof of this fact, which are based on assumptions of equal currents, equal power factors, or of equal e. m. fs. per phase, are evidently open to many objections. A simple semigraphical proof of the correctness of the two wattmeter methods of measuring power in a three-phase circuit under any condition of service is offered below.

In Fig. 3, let the sides of the triangle ABC represent the relative values and phase positions of the three e. m. fs. of an unsymmetrical three-phase system. Assume the receiver to be delta connected, and let I_{AB} be the current in coil AB, and θ_{AB} be the angle of lag of this current with respect to the e. m. f. of the coil. Similarly, let I_{BC} and I_{AC} represent the value and phase position of the currents in coils BC and AC. No restriction is made as to the values of currents, e. m. fs. or as to the several lag angles.

Let a wattmeter be connected with its current coil in lead at A, and its e. m. f. coil across between this lead and lead C. Also a wattmeter at B, with pressure coil between B and C. Each wattmeter will show a deflection, which may be represented by $W = EI\ Cos\ \theta$, where I is the amperes in the current coil, E is the volts across the e. m. f. coil, and θ is the angle between this e. m. f. and the current I.

For sake of simplicity in explanation, assume, in the first place, the current flowing in coil AB to be absent while measurements are made upon the watts supplied to the other coils, as indicated by Fig. 4. Evidently the sum of the readings of the meters as connected gives the watts in the two remaining coils, since each meter is connected as though measuring power in a single-phase circuit. Now assume, in the second place, the current to flow in coil AB alone while the currents in the other two coils are absent, as shown by Fig. 5. According to proof given below, the wattmeters as connected now register as their sum the true watts supplied to coil AB. When all three currents flow simultaneously, each wattmeter will show a deflection equal to the sum of its two previous readings, since its e. m. f. coil has undergone no change in connection and the two currents causing the former deflections are now superposed or the true energy transferred will be properly recorded by the two meters.

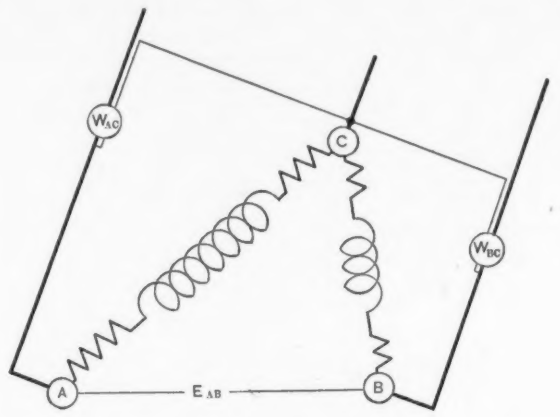


FIG. 4.—MEASURING POWER IN COILS AC AND CB.

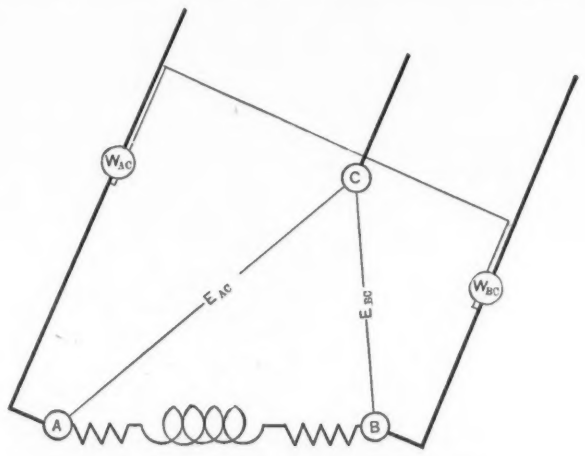


FIG. 5.—MEASURING POWER IN COIL AB.

Two wattmeters having their current coils in series with a given single-phase load, and one terminal of the e. m. f. coil of each meter connected to the opposite leads of the circuit supplying power to the load and the other two free terminals connected together and placed at any point of any relative potential compared with that of

the load, as depicted in Fig. 5, will give the true value of energy transmitted.

In Fig. 6, let E_{AB} be the e. m. f. across the load, I_{AB} be the load current and θ_{AB} be the angle between I_{AB} and E_{AB}. Evidently, the watts transmitted are

$$W_{AB} = E_{AB} I_{AB} \cos \theta_{AB}.$$

Now assume a wattmeter connected at A to C. Its reading will be

$$W_{AC} = E_{AC} I_{AB} \cos \theta_{AC}.$$

A wattmeter at B to C will read

$$W_{BC} = E_{BC} I_{AB} \cos \theta_{BC}.$$

From Fig. 6,

$$E_{AB} \cos \theta_{AB} = A F.$$
$$E_{AC} \cos \theta_{AC} = A E.$$
$$E_{BC} \cos \theta_{BC} = B D = E F.$$

and since $AF = AE + EF$,

$$I_{AB} (E_{AC} \cos \theta_{AC} + E_{BC} \cos \theta_{BC}) = I_{AB} E_{AB} \cos \theta_{AB}$$

or $$W_{AC} + W_{BC} = W_{AB}$$

and this value is independent of the position of the point C.

In consequence of this fact, P—1 wattmeters may be used to determine the true power in any P—phase system, however unsymmetrical may be the phase relations, provided the free terminals of the e. m. f. coil of each meter be connected to that lead in which no wattmeter is placed.

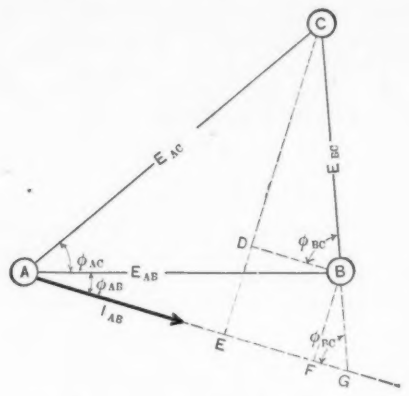


FIG. 6.—GRAPHICAL PROOF FOR FIG. 5.

Operation of Alternators in Parallel.

At the November meeting of the Société International des Electriciens, M. de Marchena read a paper on the speed regulation of alternators running in parallel. According to the author of the paper, parallel running of alternators is very greatly influenced by the regulator action, a fact which has been generally overlooked by preceding writers, at all events, in France, who have given rather too much importance to the question of irregularity during one revolution of the flywheel.

According to M. de Marchena the frequency of pulsating motive power is too high compared with the frequency of the oscillations proper ot the alternator for permitting angles of displacement between alternators to attain to a dangerous value. On the contrary, the irregularities of motive power arising from instability of the regulator are liable to produce very considerable displacements, resulting in dephasing or breaking down of alternators.

The author examines the laws which govern centrifugal regulators and particularly the relations which exist between the positions of equilibrium of the regulator sleeve and the variations of speed produced by variations of the force acting on the regulator. He considered the oscillations of the system composed of the governor and flywheel, and the frequency of the first oscillations, that is, the oscillations of the governor; also the influence of the damping effect and the conditions to fulfil for a given damping effect to prevent oscillations of the second class; that is, of the regulator and the flywheel from taking place.

The author gave a formula giving the momentum weight of flywheel to be used for a given work of a governor. He examined afterwards the working conditions of the regulator when the alternator is connected with a network. He showed that the pendulum motions and greatly variable frequencies produced through irregularities of motive power or by the quick fluctuations of load, give rise in the regulator action to oscillations, the amplitude of which depend upon the oscillations proper of this governor, as well as on its damping effect.

He examined in each case the conditions of resonance which may be obtained, and the consequences. In order to obviate these inconveniences, it has, up till now, been the endeavor to realize a very strong damping effect—at least temporarily, for the time corresponding to these abnormal conditions. M. de Marchena approved of Mr. Emmet's arrangement of dash-pot, which he thinks can sometimes give good results. He, however, estimates that it is a more rational solution of the difficulty to entirely suppress the cause of these oscillations by making the governor independent of the influence of the pendulum motions of the alternator.

He, therefore, proposed to run the regulator not by the machine itself, but by the use of an induction motor connected to the network. This motor not depending on individual oscillations of the machine, will not change its speed, and will only act on the regulator when the frequency of the network is modified.

The writer cited a test made with this system in a large hydraulic generating station in the Nice district, including turbines of 1,000 hp each. Special dispositions are employed for avoiding the troubles liable to result from accidental stopping of the motor. The first series of tests gave incomplete results on account of the excessive slip of the induction motor, which was too small. A new series of tests were made, however, with a larger motor, and the results are stated to have been entirely satisfactory. The pendulum motions which were experienced at first entirely disappeared.

It is anticipated that this system is likely to be of general use, and the author expects it to be shortly employed for facilitating parallel running of stations separated by long distances.

Electric Light in Canada.

Mr. George Johnson, of Ottawa, the Dominion statistician, has revised his statistics for publication in respect to the use of electricity for lighting purposes. He shows that the number of companies doing business in electricity, in connection with lighting, has increased from 259 in 1898 to 312 in 1902. The number of arc lights increased from 10,389 to 12,884 during the same period. The incandescent lamps number 995,056, making an increase of 179,380 lamps over last year and 531,441 over the year 1898. Reckoning each arc lamp as equal to ten incandescents, the use of electricity as a light giver, has developed in Canada during the past four years from 565,505 lamps in 1898 to 1,125,896 in 1902.

Of the total 312 companies, Ontario has 195, or 62½ per cent. Ontario cities, towns and villages avail themselves of electricity, as a light bearer, to a much greater extent than the other provinces. There are over 110 of these communities in which electricity is used for lighting, and of these more than a score operate their own lighting establishments. Several cities and towns have more than one plant.

Quebec Province has 3,605 arcs and 340,120 incandescents, or reduced to the standard of incandescents, a total of 376,170 lights, an increase of 218,979 in four years, but of this total the city of Montreal has 208,718. In the whole province there are 52 plants. Nova Scotia's equipment of 409 arcs and 46,475 incandescents, equal to 50,565 incandescents, is distributed among 22 cities and towns, and is supplied by 24 companies. New Brunswick is supplied with the electric light by 11 companies and municipalities. Prince Edward Island's modest share in the total of Canada is three electric light companies with 87 arcs and 11,300 incandescents. Manitoba has six plants, distributing light by 53 arc and 26,635 incandescents; the territories, five plants with 31 arc and 6,081 incandescents, and British Columbia, 16 plants with 770 arcs and 85,135 incandescents.

The Use and Advantages of the Alternating Current for Land Telegraphy—VI.

(*Concluded.*)

BY EDWIN F. NORTHRUP.

REFERRING to Fig. 32, page 898, when the operator wishes to transmit a signal he may depress the key *K*, when the trailer *t* is at any part of its revolution. If the key were to be depressed when the trailer was leaving segment No. 1 and raised again before the trailer returned to this segment, no half wave would be reversed. This,. however, cannot be done, as the trailer revolves at so great a speed that it will make more than one revolution before the hand, having depressed the key, can allow it to raise again. Suppose in transmitting a series of dots, the key is depressed for equal intervals of time, and with equal intervals separating each depression, it does not follow that the dots as received will be of equal duration and equally separated from one another. This will be made clear by referring to Fig. 34, which shows how the letter X, which consists of — ——— — —, may be sent and received.

In row *A* it is assumed that for transmitting a dot, the transmitting key is depressed for a time equal to 5½ half waves of the current, and twice this time for a short dash. The waves marked *I* are the only ones which can be modified, as these are the ones which correspond to the passing of the trailer *t*, Fig. 32, over segment No. 1. The lines drawn under the diagram of the waves have lengths proportional to the times during which the transmitting key is depressed. The half waves will be reversed as indicated in row *A*, which represents the state of affairs at the transmitting end. At the receiving end the current will be flattened out, somewhat in the manner indicated in row *B*, when the half waves have been reversed. The lines under the diagram of the waves, row *B*, show by their length the intervals that the receiving relay, R^1, Fig. 33, is against contact *k*, that is, they show how the dots and dash of the letter X would appear if received on tape. It will be seen that the first and third dot has been shortened. The dash has been lengthened a little. Now by studying the diagrams here presented it will be made evident that the percentage difference that may occur in the interval of a dot or a dash as transmitted and as received will grow less and less as the number of half waves which correspond to a dot or a dash become greater. Rows *C* and *D* show the letter X as transmitted and received when a dot corresponds to 7 half waves. The second dot as received is still only half as long as the first and the third, but D is easier to read than B. Rows *E* and *F* show the same letter as transmitted and received when a dot corresponds in duration to the time of 8½ half waves.

Here the inequalities have nearly disappeared and row *F* is perfectly easy to read. Row *G* shows the positions of the tongue of the main line relay *R*, Fig. 33, corresponding to each half wave of the current during the time that the letter X is being received. If the alternating current has a frequency of 104 periods per second, or 208 alternations per second, then rows *E* and *F* represent very brief intervals and will correspond to a speed of transmission of about 40 words per minute per operator. This is calculated thus: There are on the average six elements of the Morse code for each letter. If a dot is made equal to 8½ half waves, then about 52 half waves must pass over the line to transmit a single letter. If there are 208 half waves or alternations per second, then four letters can be transmitted per second, or 240 per minute. If five letters and one space is allowed per word, then 40 words per minute can be transmitted by a single operator, provided he has the skill to manipulate the key so rapidly. As shown by rows *E* and *F*, of Fig. 34, the signals as received will have practically the same form as the signals sent, and as previously explained, and as indicated in row *G*, showing the position of the line relay tongue, there will be no harmful influence on the sharpness of the signals, in the case of long lines, due to a "tailing out" or running together of the waves.

The principles, explained above, by which a single operator can transmit Morse signals in one direction, are readily extended to multiplex, duplex transmission. The essential connections for octoplex transmission, are given for a station at one end of the line in Fig. 35.

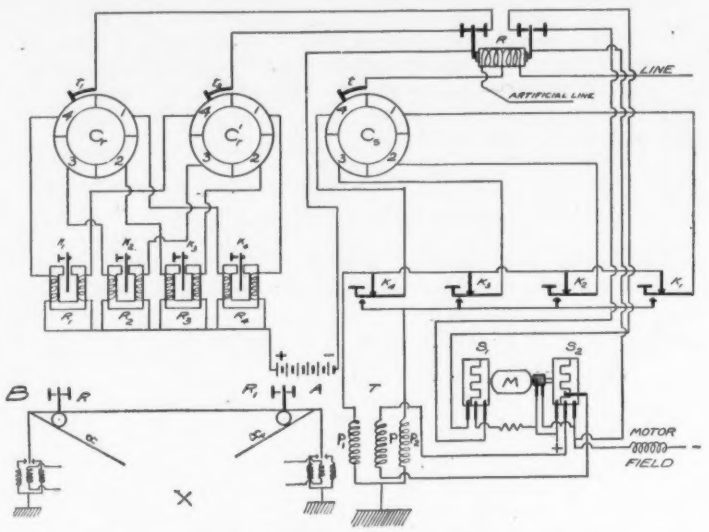


FIG. 35.—CONNECTIONS FOR OCTOPLEX TRANSMISSION.

At the other end of the line the motor which supplies the power to drive the trailers and which furnishes an alternating current by rotating a commutating device, is run at a fairly steady and independent speed. Motor *M*, shown diagrammatically in Fig. 35, is run in synchronism by any suitable method. The method here shown is the one described above as method No. 3.

We will hereafter designate the stations at the two ends of the line as station *A* and station *B*, the motor at station *B* being run in synchronism with the motor at station *A*. It is station *B* that is shown in Fig. 35. All the trailers at a station are mechanically connected to the motor at that station. Thus the trailers, t_1, t_2 and *t*, also the commutators S_1 and S_2, rotate with the shaft of the motor *M*. Hence if the motor *M* runs in synchronism with the motor at station *A*, all the apparatus at station *B* will likewise run in synchronism with the apparatus at station *A*. The line is shown du-

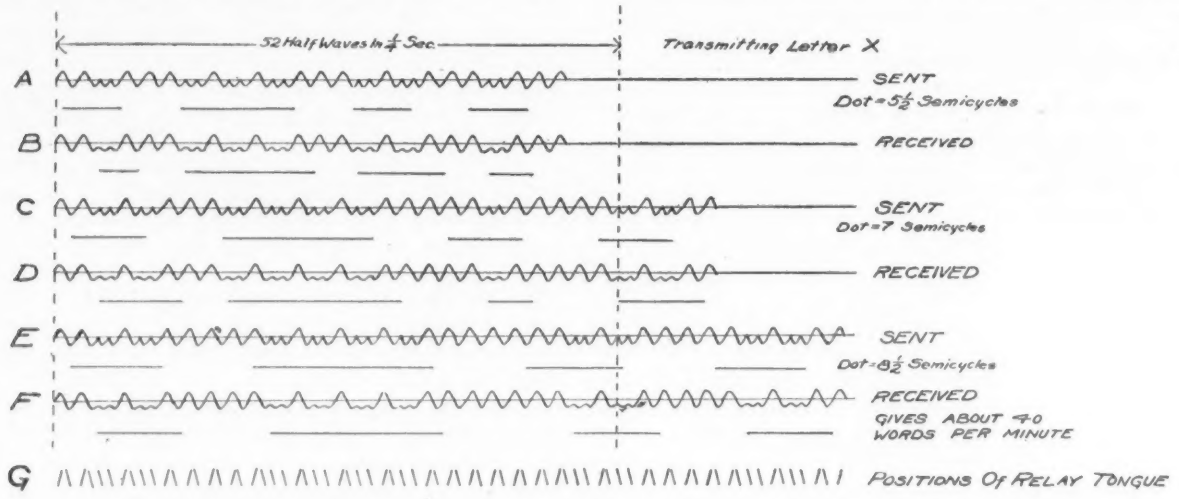


FIG. 34.—TRANSMITTING AND RECEIVING LETTER "X."

plexed. The relay R of station B and R_1 of station A (see Fig. 35) are differentially wound and one of their coils is connected to an artificial line and one to the real line.

C_S is a transmitting or sending sunflower of four segments and C_r and C_r^1 are two sections of a receiving sunflower. R_1, R_2, R_3 and R_4 are receiving relays, which possibly might be used as four sounders. If not so used the four sounders or tape recorders could be operated by the contacts k_1, k_2, k_3 and k_4. T is a transformer which furnishes the line current from its coils P_1 or P_2. K_1, K_2, K_3 and K_4 are four transmitter keys.

In transmitting each of these keys may be operated at the same time, and at any time. It will be evident by referring to the connections shown in Fig. 35, that a person operating Key K_1 can only reverse the half waves 1, 5, 9, 13, etc., that a person operating K_2 can only reverse the half waves 2, 6, 10, 14, etc., and so for key K_3 the half waves 3, 7, etc., and for key K_4 the half waves 4, 8, etc. Hence each operator in transmitting is absolutely independent of the other operators. The receiving of the signals is primarily on the main line relay R at station B and R_1 at station A, and secondarily on the relays R_1, R_2, R_3 and R_4 at station B, and on a similar set at station A.

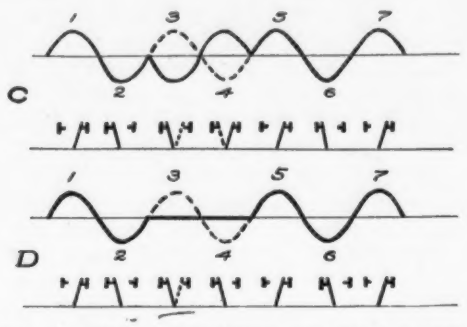


FIG. 36.—EFFECT OF CUTTING OUT HALF WAVES.

An examination of the connections will show that the receiving relays operate independently of one another. To make this plain, however, it must be shown that the relay R is active in effecting two of the relays such as R_1 and R_2, when two *adjacent* half waves are reversed by two operators at station A. If adjacent half waves were cut out instead of reversed, the second half wave cut out would not affect a receiving relay.

Referring to C, Fig. 36, the half waves 3 and 4 are shown reversed, the dotted lines giving their unmodified forms. The corresponding actual positions of the main line relay tongue are shown below in full lines, the positions the tongue would have had, if the half waves had not been modified, are shown in dotted lines. It is seen that reversing the two adjacent half waves 3 and 4 makes two reversals in the positions of the main line relay tongue. In D the half waves 3 and 4 are shown cut out.

Cutting out wave 3 leaves the relay tongue where it was carried by wave 2, and hence in a position the opposite of what it would have had if the half wave had not been cut out. But cutting out the half wave No. 4 still leaves the tongue in the same position it would have had, had the half wave No. 4 not been cut out. Hence we conclude that where adjacent half waves are to be modified it is not sufficient to cut them out, they must be reversed.

Fig. 37 has been prepared to show the modifications that would likely be produced in the line current at the sending end, if at approximately the same time operator A sent the Morse signals for the letter X, operator B the signals for H, operator C the signals for L, and operator D the signals for J. Rows A, B, C and D show the effects produced individually by each operator, and row Y shows the resulting form that the line current would take.

The lines under rows A, B, C and D represent by their spacing and length the moments when the keys are depressed and the time that they are kept depressed in sending the dots and dashes. The four rows of lines X, H, L, and J, under the row Y, representing the resultant modified alternating current, represent by the spacing and length the dots and dashes as they would be received. It is seen that they are not exact reproductions of the dots and dashes as sent, but they are not so different as to make their interpretation at all obscure. It is highly probable that in practice the duration of a dot would be considerable greater than 8½ semi-cycles of the alternating current as represented in Fig. 29, in which case the dots and dashes as received would be much more nearly like the dots and dashes as sent.

It might be supposed that when so many of the half waves are reversed that the synchronism would be destroyed. Practical experiments have been made by the writer which have proved that a very large percentage of the half waves can be modified without destroying the synchronism. Modifying 1-5th of the half waves will produce no visible fluctuations in the steadiness of the synchronism, and a much larger proportion than this can be modified without throwing the apparatus out of synchronism. Of the semicycles represented in Fig. 37, about one-half have been modified, but in the regular course of transmitting so large a proportion as this would not be modified except for brief periods, which would not destroy the synchronism. If, however, any difficulty should be experienced in maintaining the synchronism when a large number of half waves are being modified it is a simple matter to arrange to have a certain fixed number of semicycles used exclusively for the purpose of synchronism. When the apparatus at station B, Fig. 35, comes into synchronism, after being started from rest, there is only one chance in four that the trailers on the receiving commutator will be on a segment of the same number as the trailers of the sending commutator. This being the case it becomes necessary to arrange a device which will allow the trailers of the receiving commutator to slip back, one segment at a time until they rest upon the same numbered segment as the trailers of the sending commutator, or for each operator, after synchronism is established,

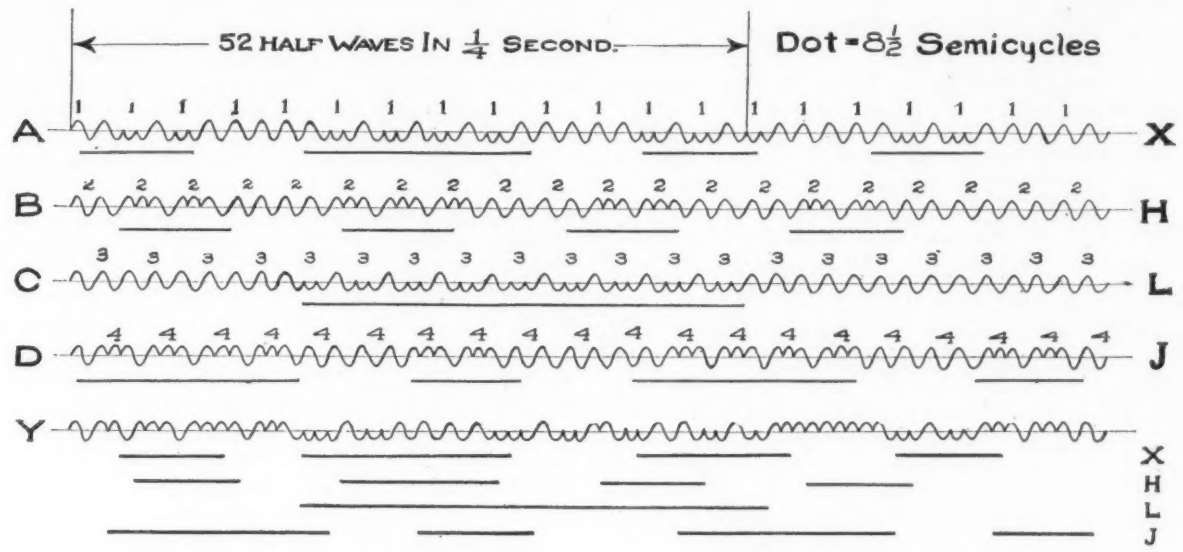


FIG. 37.—EFFECT OF SIMULTANEOUS TRANSMISSION OF DIFFERENT CHARACTERS.

to switch his receiving relay to a segment of the receiving commutator which will correspond to the sender he wishes to receive from. Either one of the above arrangements is easily made and does not need to be described in detail.

It has been shown how, by means of the alternating current, eight messages in the form of Morse signals can be sent over a long line at the same time. The number of messages, however, is not at all limited to eight. For lines of moderate length the frequency of the line current may be doubled, in which case sixteen messages could be simultaneously transmitted as easily as eight. In fact, the system is exceedingly flexible and capable of immense developments. It is, however, not my intention to specify in this article, the details of the above or any other system of telegraphy. In another part of this article it was shown how signals could be made to consist of combinations of modified half waves. Special methods have been fully worked out for receiving the signals so produced and then automatically translating them into printed characters. These methods are mostly due to Professor Rowland. They are exceedingly ingenious and practical, and have all been tested by operating on actual telegraph lines. An account of these methods, though it would be exceedingly interesting, would lead us into long detailed and special descriptions. The methods are mostly described in patent reports on Rowland's Multiplex Printing Telegraph System, to which the reader is again referred.

It would be interesting and valuable to consider the many questions of scientific and practical interest which are suggested when one has once entered upon the field of alternating-current telegraphy. But the writer must, for the time, drop the subject here.

It would be easy to allow the imagination to picture the future possibilities of synchronous alternating-current telegraphy. One sees the whole country run in synchronism and long messages dictated to typewriters and transmitted almost as cheaply as the mails are carried, and received as printed pages. Automatic typesetting machines in numerous cities are operated by a single keyboard from a central news distributing centre. Architects and engineers send diagrams and sketches by telegraph as readily as they now do by mail. Private lines run from all large business offices, and a swift, secret and cheap public telegraphic service replaces the present antiquated, slow and expensive system. But the writer does not address himself to the public imagination, but to the younger generation of scientifically trained electrical engineers who are working hard for better things. He believes that through them will come finally such a clear perception of how easy it is to beat the methods of telegraphy now used, and so stoutly defended by the representatives of the great telegraph companies, that the same rapid progress will come in the field of telegraphy that is seen in all other branches of electrical industry.

Electricity in Manila.

The Philippine Commission has passed an act providing for the granting of a franchise to construct an electric railway in Manila and suburbs, and a franchise to construct and operate a central station. The Municipal Board is empowered to grant the above franchises to the party making the most favorable bid, the bids to be received before March 5, 1903, at the office of the Municipal Board in Manila. Though a city of 300,000 inhabitants, and where the most lowly ride, there are no transportation facilities at present worthy of the name. The present horse railway is entirely inefficient, and transportation at present is almost entirely effected by about 20,000 one-horse two-wheel public vehicles called "caromatas." The present electric light plant is practically loaded up to its capacity, and it is charged that the company refuses to increase its facilities. The charges at present are $1.50 gold monthly for each incandescent light. There is a meter rate, but this is claimed to be about 75 per cent higher than the flat rate. Moreover, the company refuses to connect up installations when the wiring has been done by others than themselves, even after being approved by the city authorities. It is charged that the telephone company is similarly inefficient, with the result that there are only about 400 subscribers in the whole city, while it is believed that 5,000 could be obtained if a telephone plant were established under enterprising management.

Chicago Meeting of the American Institute of Electrical Engineers.

A meeting of the local members of the American Institute of Electrical Engineers was held at the rooms of the Western Society of Engineers in the Monadnock Block, Chicago, on the evening of December 2. From the spirit shown at that meeting, it would appear that the Chicago branch is about to enter into a new era of activity and interest, and that the local meetings there, which have heretofore been held irregularly and with uncertain attendance, will hereafter be held with certainty and well attended. In spite of most discouraging weather, the attendance was good, both in quantity and quality, forty-seven being present.

Before commencing the discussion of papers a session was held for the transaction of business, looking toward the establishment of a local branch of the Institute on a more permanent basis than heretofore. Local honorary secretary, R. H. Pierce, called the meeting to order and made a few explanatory remarks regarding the recent policy adopted by the Institute as regards local meetings. He stated that heretofore the reason for the lack of interest and attendance in the Chicago branch of the Institute was due to three things: In the first place, it was frequently the case that the papers to be read did not reach the members until the time of meeting, so that there was no opportunity to look them over and come prepared for a discussion. In the second place, the papers were frequently on subjects in which there were but few Chicago members interested, sometimes being too abstract and mathematical, or on some special branch of the art which but one or two members would feel competent to discuss. In the third place, the discussions were supposed to be confined to the papers read, and if the papers read did not appeal to many of the members, there was sure to be a lack of interest. These objections, however, Mr. Pierce said, were being removed by the present methods of the Institute. As regards getting the papers on time, in advance of the meeting, he was convinced that the proper course was to hold the Chicago meetings after those in New York. There would then be a certainty that the papers would be on hand before the meetings. As regards the nature of the papers presented, it was evident that this year the papers were of more general interest, and of a nature that could be discussed by a larger percentage of the membership than heretofore. This in itself would insure a larger attendance and better discussion at the meetings. It was further intended that the local organization should take up matters of local interest, if the papers were not of a nature which would require the full time of the meeting for their discussion.

It was voted to appoint a committee of seven, with the local honorary secretary an ex-officio member, this committee to have charge of matters pertaining to the local organization, and especially to look after the attendance. The committee appointed consists of G. A. Damon, of the Arnold Electric Power Station Company; Peter Junkersfeldt, of the Chicago Edison Company; James Lyman, of the General Electric Company; H. H. Wait, of the Western Electric Company; A. S. Hibbard, of the Chicago Telephone Company; K. B. Miller, of the Kellogg Switchboard and Supply Company, and J. R. Cravath, of Electrical World and Engineer.

After the reading of the papers on variable electric speed control, which were presented at New York November 21, an interesting discussion was taken part in by various members.

B. J. Arnold brought out the point that, while the direct driving of every machine tool in a shop was ideal in some respects, the investment called for with this practice was in many cases so great that the interest more than counterbalanced the saving in power due to the use of electric drive as against shafting. As a matter of actual practice, when it came to the equipment of a machine shop having a large number of small tools, true economy lay in grouping these machine tools on short sections of a line shaft, each section to be driven by an electric motor. The capacity of motors required by the grouping system would be but a small fraction of the total motor capacity required if each tool had its individual motor. In regard to equipment of trunk-line steam roads with electricity, as suggested in the paper of H. Ward Leonard, he did not wish to advocate any one system as against another, but he did wish to emphasize the ab-

solute necessity of doing away with substations with rotary converters in such work. His investigation of steam railroad trunk-line service recently, had convinced him thoroughly that it was absolutely useless to think of equipping steam trunk lines with a system requiring rotary converter substations. The investment in substation machinery to take care of the enormously fluctuating loads which would be thrown upon it by heavy trunk-line trains, and the attendance required at these substations would make the cost of operation prohibitive. Some system must be evolved to eliminate the rotary converter substations.

George B. Foster pointed out that where machine tools were electrically driven from individual motors the saving by the use of electric drive lay, not in the elimination of line-shaft losses, but in the ability to regulate the speed of large machine tools more accurately, to work it to its full capacity, and to get more work from a machine and its attendant. Where this was so, the question of the extra investment was a minor consideration.

Mr. Arnold, in explanation of his previous remarks, said that he indorsed the truth of Mr. Foster's statement that in some cases the greater output obtained from a machine tool by having it direct driven, overweighed all other considerations, and threw the balance in favor of the direct-driven tool, even if the interest on the investment more than wiped out any saving due to line-shaft losses. In previous remarks he had referred more especially to small machine shops, doing miscellaneous work. In a large manufacturing plant, with large machine tools, where it was important to drive each one at its maximum capacity, there was no question but that direct driving was the thing.

E. Gonzenbach referred to a concrete case which he had occasion to figure upon recently. This was the shop equipment of the Aurora, Elgin & Chicago Railway. For this shop, about $6,500 worth of machine tools were to be put in. To drive each one of these directly by an individual motor would have called for the investment of $4,000 in motors. The aggregate motor capacity for such direct driving would have been 35 hp. By grouping these tools on two line shafts, he was able to cut the motor capacity to two 5-hp motors. Of course, this was not a manufacturing plant, but only a small plant for general repairs on an interurban electric road. Referring to Mr. Arnold's remarks as to the cost of operating a steam trunk line electrically, with rotary converter substations, he indorsed Mr. Arnold's views, and referred to the present difficulty of getting competent men to take charge of substations. The substation attendant, being alone, was dependent entirely upon his own resources in times of trouble. For this reason his position was even more responsible than that of the ordinary attendant in the main power house, because in the power house there is usually a chief engineer to look to. At the present time there seemed to be a dearth of competent substation attendants, except at very high prices. On a road operating heavy trains from rotary converter substations, it is very important to avoid bunching of trains, if the investment in substations is to be kept down to a reasonable point. Even with the short trains, on the Aurora, Elgin & Chicago Railway, the substations had a capacity of 6,000 kw, while the main power station had a capacity of only 3,000 kw, the extra capacity in substations being required simply because of the occasional bunching of trains on the road.

Mr. Arnold said that he considered a fair average for locomotive repairs was 4.1 cents per locomotive mile.

Professor D. C. Jackson summed up the situation in regard to machine tool driving by individual motors as against the grouping system, by saying that the selection of an electric shop equipment was a matter of engineering common sense. If there were a lot of miscellaneous tools operating intermittently, the sensible thing to do was to group them into sections on line shafts, these sections to be driven by motors. In this way the investment in motors would be kept down, and the line-shaft losses would not be excessive. On the other hand, for large tools in a manufacturing establishment, direct driving with provisions for varying the speed to suit exactly the work to be performed on a machine, was the most economical, because of the greater output obtained from the machine tools.

H. H. Cutler criticised the Leonard system of variable speed control, not only on account of the cost and complication, but because it is sluggish in acceleration. It was impossible, he said, to vary the shunt field of the generator on the motor-generator used with sufficient rapidity to make quick acceleration, and this was what was wanted in coal hoisting and many other classes of work. He advocated for this a plain series motor, with rheostat in the circuit.

The paper by Mr. Lozier, he said, emphasized the increase in output with independently driven tools on a multi-voltage, but this was not by any means peculiar to the multiple voltage system. He was in favor of omitting all complication incidental to the multiple voltage system, and leaving the motor alone to run at its normal speed and best efficiency, obtaining the changes in speed of the tool by the use of gears. Reduction in the speed of a motor while requiring from it the same output, meant an enormous increase in the size of the motors required. Something could be learned, he thought, from gasoline automobile makers, who produce a motor of minimum weight and cost, and obtain a variable speed by means of gears. Fine adjustments of speed could be obtained at any gear ratio by a variation of the field strength of the motor. Such variation, to the amount of 15 per cent, could easily be obtained. For driving fast newspaper presses he advocated a double-motor equipment, one small motor with slow speed gear for threading in the paper, and a large motor for operating at full speed.

In response to a question as to whether the cost of gearing to secure variable speed by mechanical means was not greater than the extra cost of electric motors required for wide variation in speed control, he thought that the cost was certainly in favor of the gears. He cited cases where, with a mutliple voltage system, motors six times as large as would have been necessary with mechanical speed control were required to operate a certain tool at slow speeds. In regard to the cost of gears, Mr. Arnold thought that for new tools where the gears were made a part of the tool, that the gears would probably be cheaper than the additional cost of motors and equipments for variable speed by electrical means. For old tools, for which gears would have to be specially adapted, the extra motor capacity and equipment might be the cheaper.

Mr. George A. Damon, in a communication after meeting, said that there was no doubt but that the individual motor was gaining favor, as the advantages of its use became more generally understood, and as investors began to appreciate the dividend-earning capacities of investment in electric-drive equipment. It would be instructive to determine under what circumstances a separate motor on each machine would be justifiable. If the shop was to have an entirely new equipment of tools, the use of a separate motor for each machine should be carefully considered. Nearly all tool builders are now accommodating their products to driving by an individual motor. With the higher cutting speed made possible with the individual drive, and with the deeper cuts allowed in new steel and other materials, it did not seem unreasonable to expect the new tool, which has been designed with these conditions in view, to have an output at least 50 per cent. greater than a tool for the same class of work than the former belt-driven type. But it often happened that the shop tool equipment includes a number of tools which have already been used in an old shop, and which were poorly adapted to direct connection to individual motors. To put an individual motor on each lathe would sometimes require at least six times greater investment than to drive a group from a line shaft.

The tendency at present seemed to be to arrange the old belt-driven tools in groups, allowing a ten to twenty hp motor for each group. If the shop was to be run on a piece-work or premium system of compensation for its mechanics, then the use of elaborate systems of speed control might be justified. If each operator had a constant incentive to keep the output of his machine up to its full capacity, and it were possible to vary the output by changing the speed by easy steps, through a wide range, then the efficient results attained through the operation of the tool at all times, at highest permissible speed, might make the question of extra investment insignificant. On the other hand, there were situations in which an easy method of controlling the speed may be a disadvantage. For a large printing establishment it was once found necessary to design a device to lock the speed controllers, so that if the press was run at all it was operated at a different speed, which speed was determined by the foreman for each job. This way it was made impossible for the feeders to loaf. This incident emphasizes the idea that if full advantage is to be taken of electrical control, the operators should also be worked up to their highest efficiency.

Telephone Cables—II.

By Arthur V. Abbott, C. E.

MECHANICAL PROPERTIES.

ONLY the electrical properties of cables have so far received attention, but certain mechanical characteristics are essential to permit of installation and to preserve the cable in working order. The integrity of the cable depends on the integrity of the sheath, which must be of sufficient strength to withstand without rupture all the manipulation necessary to transportation and erection.

The thickness of the lead sheath varies slightly with different makers, but experience has shown that for 25 pair and less, 1-16 inch is sufficient, from 25 pair to 50 pair 5-64 inch, from 50 pair to 150 pair 3 3-2 inches, and over 150 pair ⅛ inch. To economize weight aerial cables are usually made of slightly thinner sheath than underground, and of No. 20 gauge instead of No. 19.

Early cables were supplied with sheaths of pure lead, but frequent corrosion was experienced, to obviate which an alloy of about 3 per cent tin was substituted, or a subsequent wash of pure tin was applied, after the wire was enclosed in the pipe, by drawing the completed cable through a bath of melted tin. Of the two processes, the lead-tin alloy yields the most desirable results in the ducts, though with it is somewhat more difficult to secure a sheath absolutely free from pinholes and cracks. The addition of the tin has been found so beneficial that little cable is now made without it. Cable of No. 19 gauge is somewhat easier to splice than that made of smaller wire, chiefly because there has been much experience with this size, and cable makers know exactly how to handle it, so with small gauges greater care must be exercised till more experience is gained. The strength of the cable is limited to that of the lead pipe, for the loose core of paper-covered wire possesses no resistance in any direction. Much care is therefore essential in handling so fragile a structure as a 2½-inch lead pipe, ⅛ inch in thickness, and several hundred feet in length. When placed on reels if too long lengths are used the inner layers are crushed by the weight or tension of the exterior ones. A sudden or sharp bend will produce a kink in the sheath that flattens the contained circuits together, and is likely to rupture the paper and produce a lot of "shorts," or even may develop a crack in the lead that will pass undetected until the entrance of moisture causes the entire cable to utterly fail.

In erecting cable, either aerial or underground, the cable should be drawn off the reel directly into place ,and not pulled over rough pavements or gravelly roads, where injury to the sheath is almost inevitable. It is claimed that the sheath of cable so placed as to be exposed to constant vibration (on bridges, for example) will gradually crystallize and rapidly deteriorate to a point of no longer affording protection to the circuits. As most instances of this nature when carefully analyzed are found due to defect in original materials, or workmanship in manufacturing, little apprehension on this score need be entertained under all ordinary circumstances.

SPLICES AND TERMINALS.

Owing to the hygroscopic and fragile character of the paper insulation, special care must be observed in terminating and joining cables, in order to keep the main body moistureless. Each piece of cable as delivered by the manufacturers has some 3 feet or 4 feet of each end boiled in paraffine, after which the lead of the sheath is turnd over and soldered; in this condition the cable will keep indefinitely. When two pieces are to be joined the sheath is stripped away from each end for 18 inches or 2 feet. Then a piece of lead pipe an inch or 1½-inch larger than the cable and about 2 feet long is slipped onto one of the cables. The paper from individual wires is then stripped off, and each wire in one cable twisted to its proper mate in the other, the wire joint being protected by a paper sleeve. When all the pairs are then connected the lead sleeve is slipped over the splice and one end "wiped" onto the sheath of one piece of cable, the splice is then "boiled" out by being immersed in boiling paraffine for some little time, after which the remaining end of the sleeve is wiped onto the sheath of the other cable and the splice is complete. Full details of this method will be found under the head of *"Specification for Cable Splices."*

Cable Heads.—The termination of the cable is a much more difficult matter in order to secure complete immunity from moisture for here the individual wires must be brought out in such a way as to be utilized in any desired manner. There are two general types of terminals—*The Cable Head* and *The Pot Head.* The cable head consists of some sort of an air-tight box, or receptacle, to which the sheath of the cable may be soldered, and inside of which the circuits may be fanned out and attached to pins or studs extending through the sides of the box, thus affording exterior connection to each cable wire. After the cable sheath is attached to the head and the wires connected to the terminals the head is sealed up.

The Pot Head method consists in splicing onto the paper cable an auxiliary cable, long or short, as circumstance may indicate, made of wire insulated with some non-hygroscopic material (say, rubber), and covering the joint with a lead sleeve, wiped onto the cable sheath, which is subsequently filled with a rubber compound such as Chatterton's. The cable head is the older plan, somewhat easier to successfully install, has the advantage of affording an excellent opportunity to test circuits, and lends itself to the easy attachment of protectors; but takes up a great deal more room, and is much more expensive. The cable head presents itself in a legion of different forms. The plain head or one unequipped with protectors, Fig. 7, is most usually made as a rectangular iron box about 6 inches or 8 inches wide by 4 inches or 5 inches deep, and of varying lengths sufficient to accommodate the different sizes of cable. In one end a piece of brass pipe is threaded, to which the cable sheath is to be soldered, and through which the cable pairs pass to the interior of head. Along the two opposite sides a series of insulated pins (often in the form of binding posts or supplied with a pair of threaded washers) corresponding to the number of cable wires are placed, to which, on the inside, the cable pairs are soldered, and from which on the outside the circuits are extended. One face of the head is in the form of a cover supplied with rather heavy bolts to draw it firmly against a rubber gasket making an air-tight joint. A very neat and compact, though somewhat expensive design, as it is made of rubber, is shown in Fig. 8, also illustrating the cable in place. Fig. 9 shows a cable head supplied with pro-

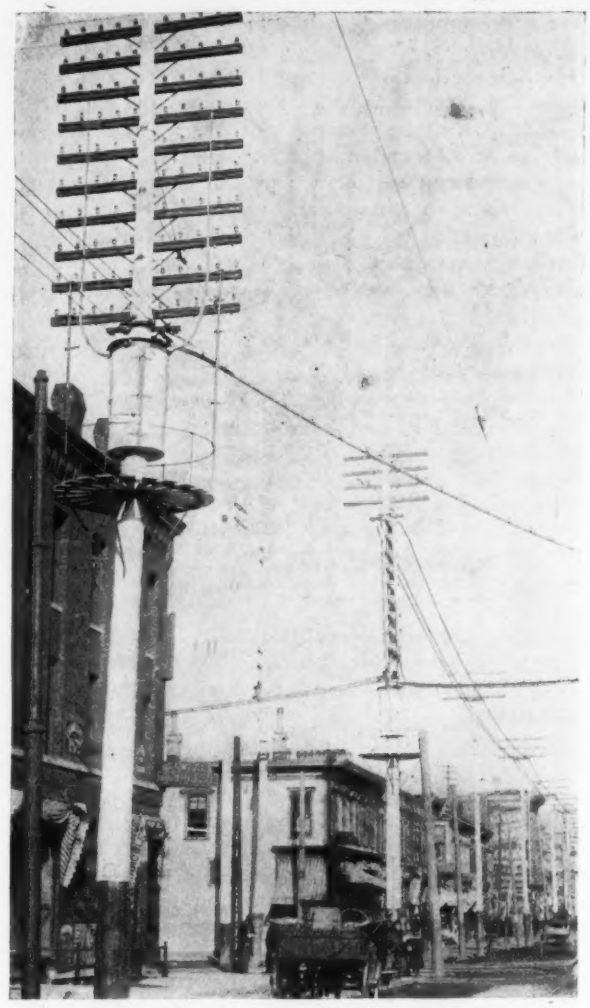


FIG. 11.—CONNECTING CABLE AND OPEN-WIRE LINES.

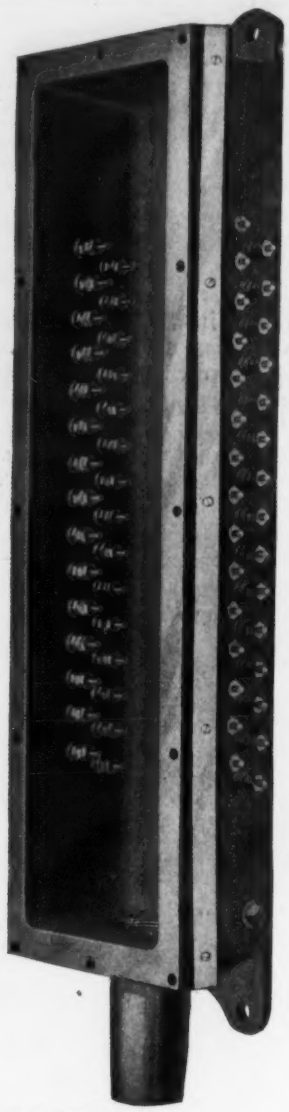


FIG. 7.—PLAIN CABLE HEAD.

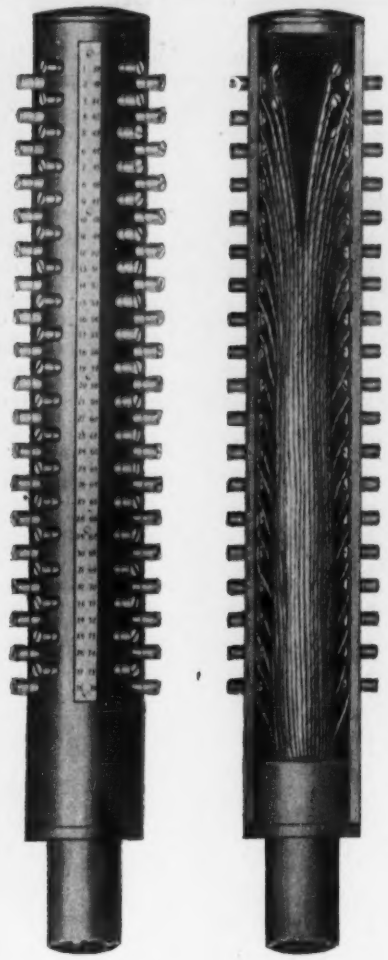


FIG. 8.—CABLE HEAD.

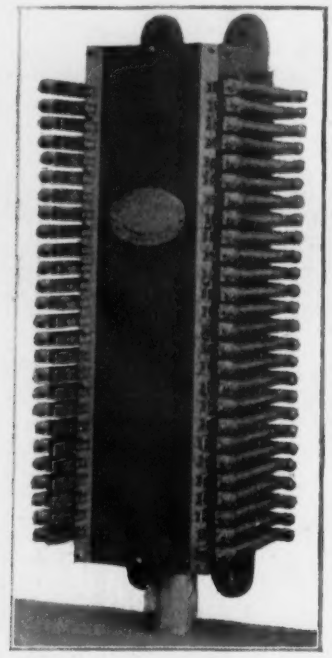


FIG. 9.—CABLE HEAD WITH PROTECTORS.

TELEPHONE
CABLE HEADS,
ETC.

ABBOTT ARTICLE.

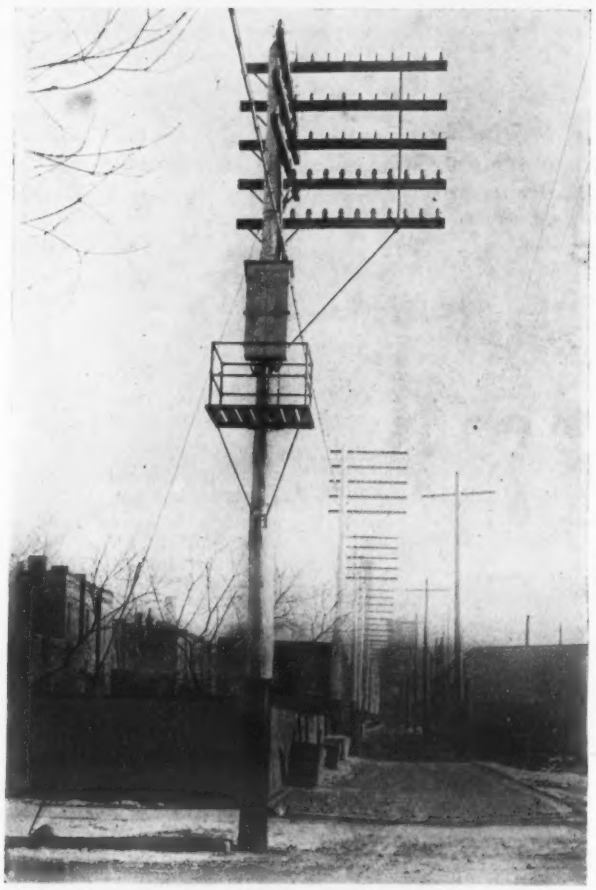


FIG. 10.—CONNECTING CABLES AND OPEN-WIRE LINES.

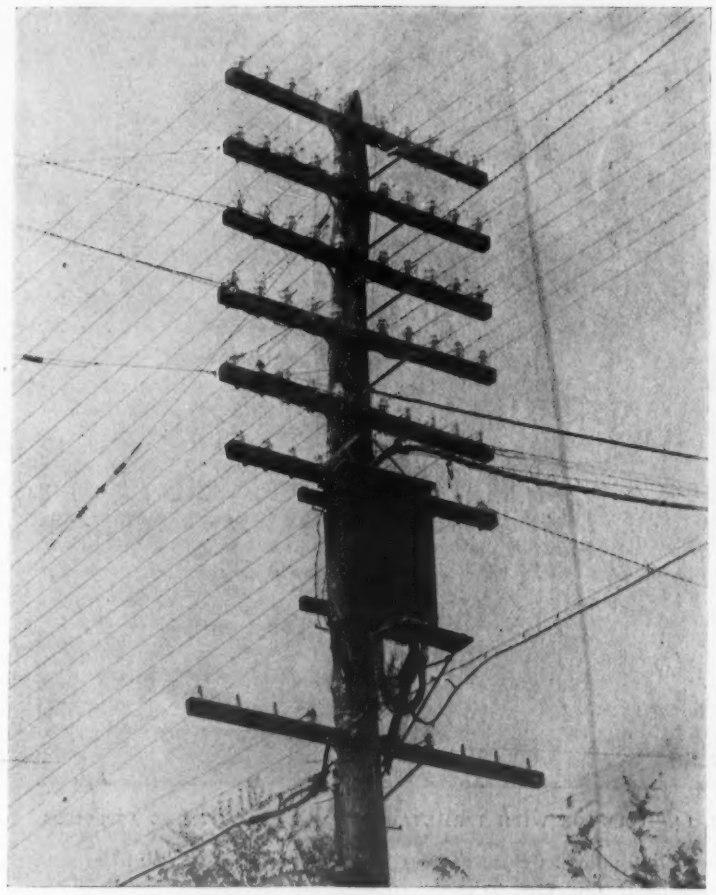


FIG. 12.—"TROUBLE-INVITING" TYPE OF CONSTRUCTION.

tectors, each line having a set of carbon plates and fuses, suitable for an office terminal in connection with an unprotected distributing board. Modern practice, however, strongly tends toward making the

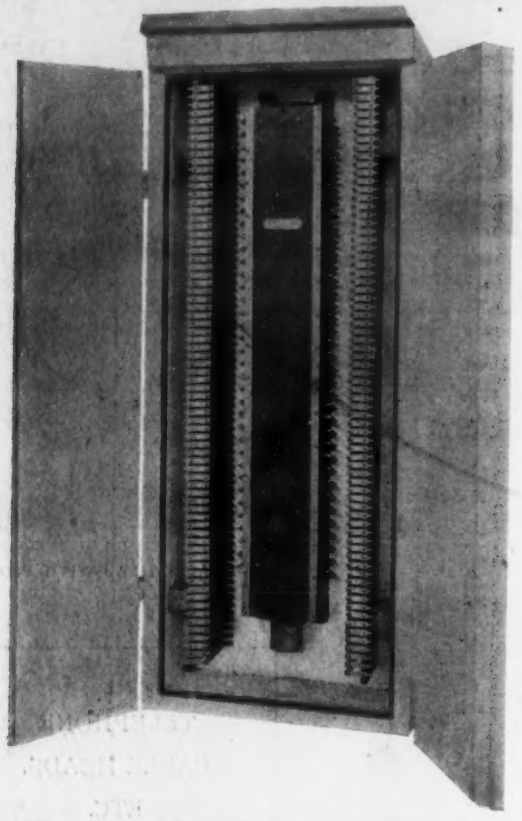


FIG. 13.—INTERIOR VIEW OF CABLE POLE BOX.

cable endings in central offices as simple as possible, and concentrates all protection on the main distributing board.

Where cables run into open wire lines the head must be placed

FIG. 14.—POLE BOX WITH TERMINAL HEADS AND LIGHTNING ARRESTERS.

on the line poles as close as possible to the cross-arms, and the pins of the head connected to the open wires of the aerial lines by short lengths of rubber-covered wire, called "bridle wires" or "jumpers." It is usual to enclose the head in a box provided with doors, to protect it from the weather, and house the fuses and lightning arresters that must be inserted between the cable head and the open wire to guard the former from atmospheric electricity, and accidental crosses with other electric wires. To facilitate the duties of linemen, a platform or "balcony," as it is technically termed, is built just below the cable head. The general method of connecting cable and open-wire lines as represented by examples in good practices, is shown in Figs. 10 and 11, showing a neat and orderly arrangement of circuits, and two varieties of cable boxes. In Fig. 11 the forms of rubber jumper wire connecting the cable to the open wire are seen extending on either side of the cross-arms. Fig. 12 is the type of construction usually found in middle-sized towns, and is an excellent example of "what not to do." No design is displayed in the wiring on the contrary everything is at "loose ends." The cable hangs in a sharp bend; and in general the whole pole presents a *strong* temptation to the "trouble devil." The details of cable pole box construction are shown in Figs. 13 and 14. If the head shown in Fig. 9 be employed it is simply bolted to the back of the box, and the jumper forms attached to the ends of the fuses and run down through holes in the bottom of the box (to prevent the entrance of water), and up to the cross-arms. If plain cable heads are used (Fig. 7 or 8) the box must be made larger and the

FIG. 15.—POLE-TOP TERMINAL.

protectors placed on strips attached to the back of the box, as shown in Figs. 13 and 14.

A very ingenious pole terminal is shown in Fig. 15, designed to be placed as a cap on the top of the pole. From Fig. 15 it is seen to consist of a heavy iron pan provided with a water-tight cover. The cable enters through a hole in the bottom, to which the sheath is soldered, while the terminal pins project through the circumference of the pan. After being secured in the place on the top of the pole, a copper cover is dropped over the entire terminal, thus effectually shielding it from the weather.

The head is secured to the pole by cutting off the top square and bolting thereon the spider shown at the right hand of Fig. 15. On this the head is attached, the spider also serving to hold subscribers' lines when house distribution is made directly from the cable head. Figs. 16 and 17 show this head as it appears in practice.

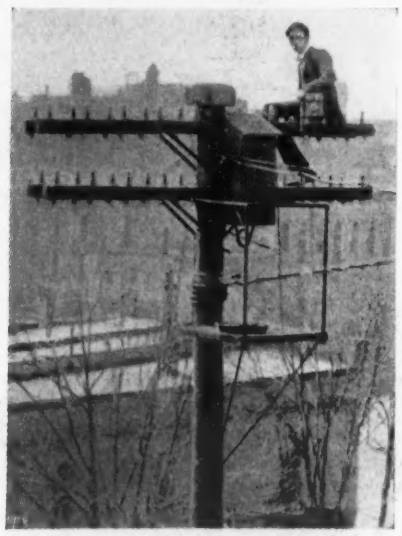


FIG. 16.—POLE TOP IN POSITION.

Present practice is tending strongly toward the wider employment of cable in all cases, and it is now common to extend aerial cable from block to block, placing a distributing pole in each one,

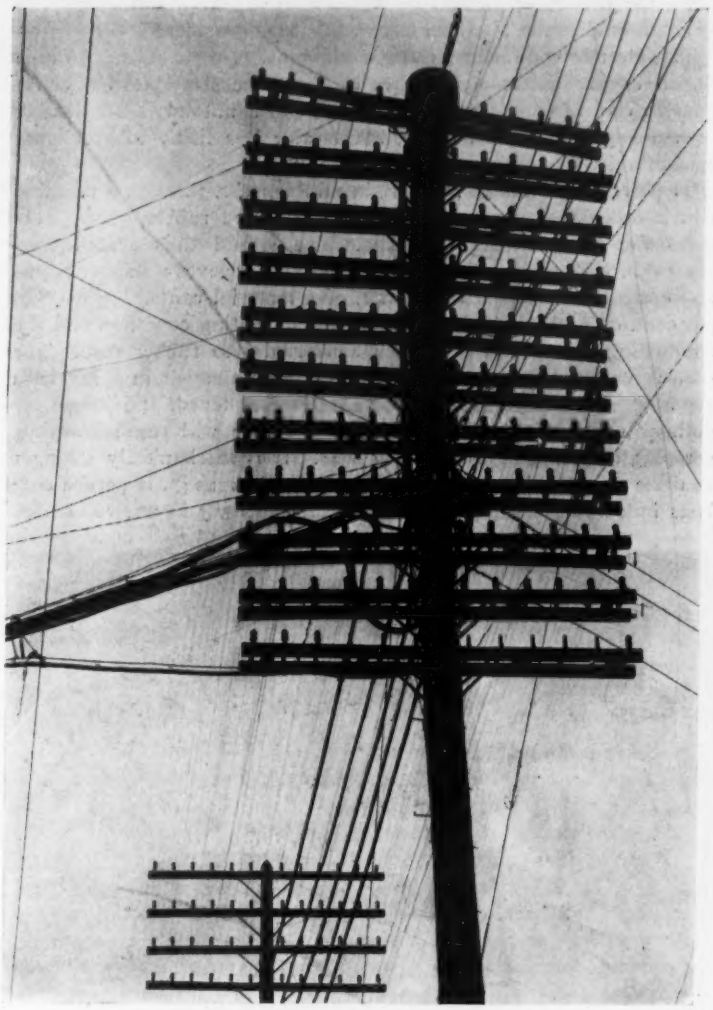


FIG. 17.—POLE TOP IN POSITION.

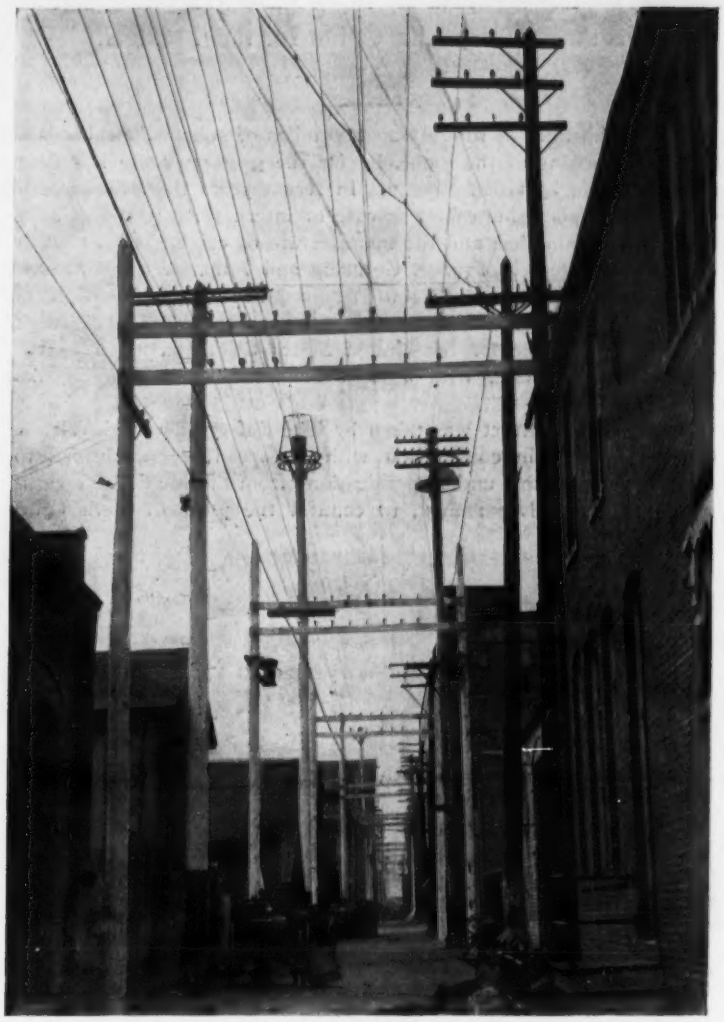


FIG. 18.—EXAMPLE OF DISTRIBUTION IN A BLOCK.

having a cable head into which sufficient pairs are taken by a Y splice to serve the block, and from which the subscribers' drop wire hang in single spans to each house. By this means, rights of way questions are entirely avoided, and a method of distribution at once cheap to install and easy to maintain secured. Fig. 18 is a good example of the general features of this practice, while Fig. 19 shows the detail of distribution.

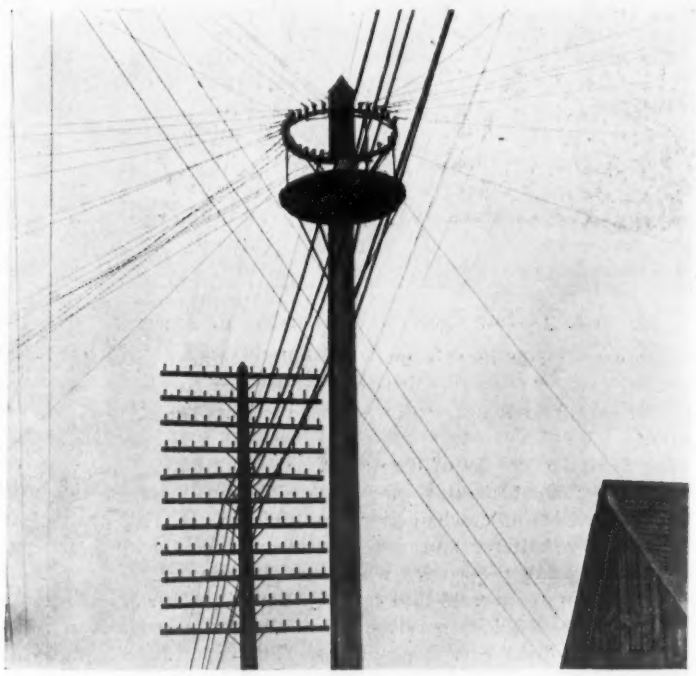


FIG. 19.—DETAIL OF DISTRIBUTION.

Canadian Long Distance Transmission.

The city of Montreal is rapidly enlarging its supply of electrical energy, in order to meet the constantly increasing demand for electricity for light and power purposes. The result of this increasing demand is shown in the fact that the Lachine Hydraulic & Power Company is now bringing electricity from Shawinigan Falls, eighty-five miles distant from the city. The transmission line is already completed and the power houses at the Montreal and Shawinigan ends are finished. At the beginning of the new year one of the longest of transmissions will be in operation and will be conveying 8,000 electrical hp into Montreal. It has been a big undertaking, but it has been carried out with remarkable expedition.

Some 4,500 cedar poles have been planted for the support of the three aluminum conductors which are strung upon them. Each conductor consists of six three-eighths-inch wires twisted together. A special insulator of porcelain has been used.

At Bout de l'Ile the river is spanned and the island of Montreal reached by means of a heavy steel cable, suspended above the water from two steel towers, one on each shore. The span is 1,800 feet in length. The current is brought into the city at 50,000 volts. At the distributing station the current is stepped-down to 2,000 volts and the 8,000 hp will be delivered to the Lachine Power Company at that pressure. One of the interesting features of the work, to Canadians, is the fact that domestic aluminum is used. It is the first output from the factory of the Northern Aluminum Company, the Shawinigan branch of the Pittsburg Reduction Company. It is expected that this Shawinigan plant will, in a few years, be the largest aluminum-producing plant in the world. Although a long transmission has never been tried in a climate as severe as that which prevails in this part of Canada, yet there is no doubt entertained as to the success of the present enterprise.

The Manufacture and Laying of the Vera Cruz-Frontera-Campeche Cable for the Mexican Government.

Of the sum total of roughly 200,000 miles of submarine cable laid across the oceans of the globe, by far the greatest share has been made and laid by Great Britain. In recent years the strategic advantages of submarine cables in case of international disputes have been clearly exhibited, and the manufacture of cable has been taken up to some extent in France, Germany and Italy. Within the last few years submarine cable has been manufactured by industrial corporations in the United States. One company alone has made about 2,000 miles of cable for the United States Government, which the Government has laid, with a cable ship of its own, among the Philippine Islands.

This year a contract was taken by The Safety Insulated Wire & Cable Company, in competition with European manufacturers, to make and lay a cable under specifications from the Mexican Government Telegraph Department, to connect the ports of Vera Cruz, Frontera, and Campeche in the Gulf of Mexico. The contract length of this cable was 472 nautical miles, or 544 statute miles. This cable has recently been made and laid, and since it is the first cable made in America for foreign owners, and also the first cable of any considerable length laid by an American cable manufacturing company, the story of its manufacture, shipment, and delivery on the selected sea-bottom route may be of interest.

The engineering specifications for the manufacture of the cable were drawn by Mr. Ira W. Henry, vice-president of the Safety Company. The contract specified the nature and length of the cable, the details of its parts, in relation to sizes, qualities and tests, the equipment of the cable-houses, or terminal buildings which the company was to erect, the depths of water in which the cable was to be laid, and many other particulars. The cable was manufactured at the Safety Company's works at Bayonne, on the water front of New York Bay.

Inasmuch as the details of size and construction differ considerably in different cables, according to the depth of ocean, topographical conditions, and the views of the engineers who draw up the specifications, the particular process of manufacture to be described applies in detail only to the Mexican Gulf Cable here considered.

The electric conductor of the cable consists of a strand of nine tinned copper wires—eight wires of the same size spiralled about a larger central wire. A stranded conductor is not only more flexible than a single-wired conductor, but is also less liable to accidental discontinuity by rupture.

The stranded conductor is run, in mile lengths, through a machine which lays on a thin seamless coating of pure rubber gum. This gives the first insulating coating. The strand thus coated then passes through a second machine, in which it receives a thicker seamless coating of vulcanizable rubber, or a material containing over 40 per cent. of rubber. This completes the insulating covering, and the conducting strand has then been converted into rubber core. The core is vulcanized in its outer coating, by immersion in a hot bath for a suitable time. The finished core is then taped, and joined together in five-mile lengths. This rubber core will stand knotting, scraping and rubbing remarkably well. It is mechanically stronger in these respects than gutta-percha core. Whereas gutta-percha core lasts indefinitely under water, but oxydizes slowly in air, vulcanized rubber core, made in this manner, will last indefinitely either in water or in air. Moreover, it is not injured or affected by exposure to relatively high temperatures, such as the temperature of boiling water.

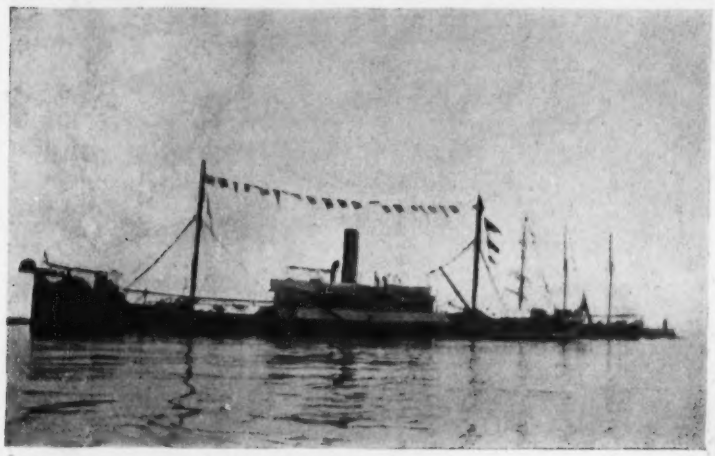


FIG. 1.—CABLESHIP "YDUN."

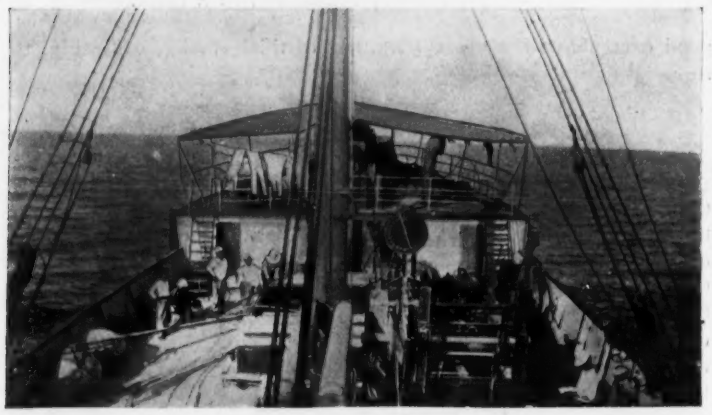


FIG. 2.—FORWARD DECK AND PAYING-OUT GEAR, STEAMER "YDUN."

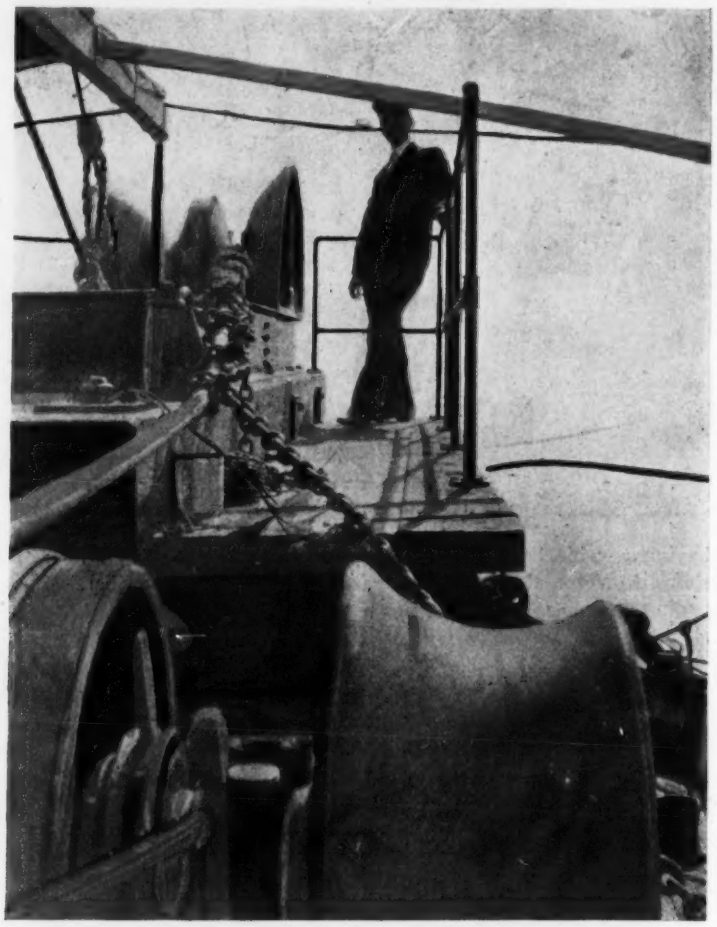


FIG. 3.—BOW SHEAVES WITH CABLE IN STOPPERS.

The five-mile lengths of core are then subjected to 5,000 volts of alternating-current pressure for five minutes, to make sure that the core contains no cracks or incipient defects. It is also tested for insulation by battery, and for capacity and conductor-resistance. After undergoing these tests while immersed in water, the core is ready for being converted into cable by the process of armoring.

An armoring machine consists essentially of a long series of vertical revolving disks carrying spindles. The disks are separated by troughs. The core passes through the series of disks through central apertures, and through the troughs between them, receiving from the spindles at each disk a layer, in spiral form, either of jute, or tape, or steel wire. In the troughs it receives coatings of compound of tarry character and appearance. On entering the machine, the core passes through the centre of two disks in succession, and receives two layers of jute, laid on in opposite directions. Then it passes through the

center of a disk which lays on 16 steel wires, each galvanized, compounded and taped. The next two disks apply two more servings of jute in opposite directions, after which the cable receives a coating of preservative compound, and a final coat of talcum to make its surface non-adhesive. Thus the core, steadily entering the machine at one end, comes out as continuous finished cable at the other, ready for shipment or coiling away in steel tanks, where it can be kept and tested under water. The dielectric strength of the insulator is tested by the application of 1,000 volts of direct-current pressure, and the usual insulation, capacity and conductor-resistance tests are applied by battery.

As each of the 16 armor wires will withstand about 1,000 pounds pull before breaking, the breaking stress of the cable is in the neighborhood of eight tons. This is with the deep-sea cable, for laying in relatively deep water. Near the shore, and in shallower water, a heavier cable is used, or a "shore-end type." This shore-end cable is made by passing deep-sea cable through another armoring machine, where it receives an external sheathing of 18 galvanized steel wires, as well as external servings of jute and compound. The breaking stress of the shore-end cable is thus raised to about 20 tons.

The shore-end cable has a diameter of about 1⅔ inches, and weighs 6½ long tons to the nautical mile, in air. The deep-sea cable or lighter cable, has a diameter of about 1 1/9 inches, and weighs 2½ long tons per nautical mile.

As the Safety Company did not possess a cable-ship of its own with which to lay the cable, it was necessary to charter a vessel for this purpose. There was considerable difficulty in securing a suitable vessel. The total weight of the cable was 1,500 short tons, and its total coiling space was no less than 28,000 cubic feet. The cargo space available on an ordinary steamer of 1,500 tons carrying capacity is commonly 80,000 cubic feet, or nearly three times more than the cable would occupy. But in the ordinary cargo steamer the space is arranged in such a manner that but little of it is available for stowing cable. In order to be paid out safely, the cable must be coiled away in large tanks, nearly the breadth of the ship in diameter, and these must be open cylinders from the top to the bottom; whereas the ordinary ship has "between-decks" that are continuous fore and aft, except for relatively small hatches. Enlarging these hatches sufficiently to allow the tanks to be erected involves cutting

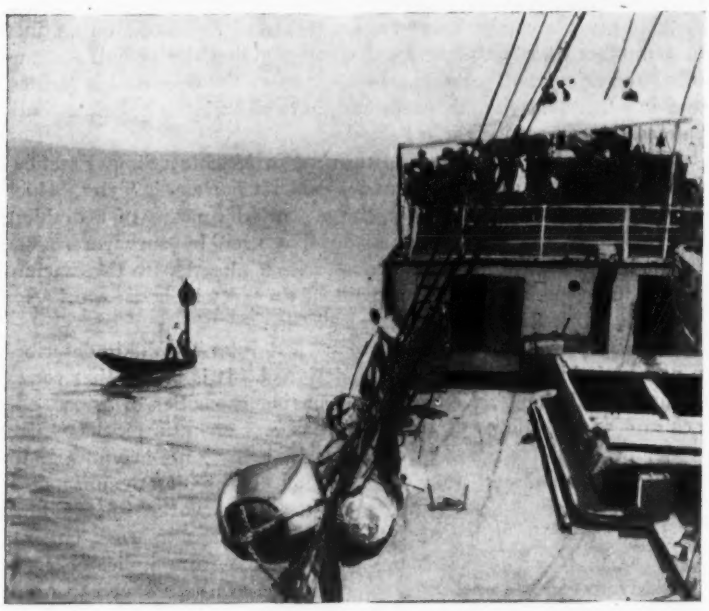


FIG. 4.—SETTING MARKING-BUOY AT SEA.

steel beams, stringers, diagonals and hatch combings, at considerable expense to remove and subsequently restore. If no deck cutting is attempted, then it would probably require a 10,000-ton ship to receive the 1,500 tons of cable.

After a number of vessels had been examined with a view to equipment as cable ships, without success, they secured, under contract, the steamship *Ydun* (Captain Christiansen). The construction of this ship was well adapted to the purpose. This vessel had no 'tween deck, forward or aft; so that below her main deck she was built like a huge steel box. Consequently, in order to make room for the four cable tanks required, it was only necessary to remove some vertical steel stanchions and compensate for their strength by some trusses and tie rods close to the under side of the deck. The steamer is 240 feet long, with a beam of 25 feet, and a carrying capacity of 2,000 tons.

The cable tanks were made of wooden crib cylinders. In each tank the crib was formed of a circular row of 12-in. x 8-in. vertical timbers, 2½ ft. apart, at their upper ends. They were supported laterally by ties between them, and by other ties to the sides of the ship. They were also girdled by steel ropes, drawn tight by wedges, driven and

FIG. 5.—LANDING SHORE END AT CABLE HOUSE AT FRONTERA.

nailed. In the center of each tank, a timber conical frame or cone was erected. In addition to the tanks, eight extra cabins had to be built below the bridge to accommodate the cable-laying staff, and a testing room had also to be built. On deck, the large cable-winch or picking-up-and-paying-out gear was erected. This carries a six-foot steel drum around which the cable passes either into or out of the ship. It has a double horizontal engine to drive it, when picking up at either of two speeds; while a brake is attached for use in paying out. This cable gear occupied 17 ft. x 11 ft. of deck space. It was built to specifications by the Lidgerwood Manufacturing Company, and was the largest and strongest cable gear that has yet been built in America. Besides the gear, large bow-sheaves had to be mounted over the stem, a smaller pair of sheaves at the stern, a dynamometer to indicate the tension on the cable, and various guide sheaves to lead to and from the various tanks. This alteration and equipment was carried out at the Robbins' Dry Docks in Brooklyn, N. Y.

The electrical equipment of the vessel consisted of a small steam-dynamo for incandescent lighting, 400 cells of battery, two D'Arsonval marine reflecting galvanometers, rheostats, Wheatstone bridges, portable testing sets, and a complete Morse signalling outfit. Nearly all of the electrical testing instruments were furnished by Messrs. Leeds & Company, of Philadelphia.

The *Ydun* was handed over to the Safety Company under charter for the reception of cable in her tanks at Brooklyn, on the 19th of August. At that moment lighters loaded with the cable from the Bayonne factory were waiting alongside, and the coiling of the cables from the lighters into two of the tanks commenced forthwith. All the cable was coiled on board the ship by the 2nd of September, and the vessel left Brooklyn with the cable, cable-staff and crew, on the 3rd of September, bound for Vera Cruz. That port was reached safely and uneventfully on the 13th. Here the ship was joined by the representative of the Safety Company, Mr. Ira W. Henry, accompanied by the Mexican Government officials, Messrs. A. Parra, Inspector General of Mexican Telegraphs, and Capt. D. Almedo, engineer, with two assistants, who attended the laying of the cable on behalf of Senor Camile A. Gonzales, the Director General of the Mexican Government Telegraph Department.

The cable house for receiving the cable was landed in sections, and erected in the adjoining bay north of Vera Cruz harbor, well above high-water mark, and about two miles from the town. Arrangements were made to secure a lighter and steam launch to land the end on the beach. Two miles of shore-end cable was coiled in the lighter, and this was then towed by the launch round to the north bay. The lighter anchored outside the surf in about four feet of water, near the beach, and with the aid of men, boats and mules, the end of the

cable was hauled ashore and connected into the cable house. The steam launch then towed the lighter slowly seawards along the selected course, and the lighter paid out the two miles of cable as she went, buoying the sea end in 10 fathoms of water, at a position where the ship could readily come in and reach it.

On the day following (September 18) the *Ydun* left Vera Cruz harbor and came round to the buoy over the sea-end of the north bay. The sea-end was soon picked up, and after speaking and testing through the cable to the cable house, the deep-sea cable in one of the tanks was spliced on. Shortly after sunset the splice was finished. The ship swung round on her course seawards, and commenced laying the cable towards Frontera, steering during the night by the bearings of the lighthouses in the neighborhood.

After steaming steadily for two days and nights at an average speed of nearly four knots, the ship arrived off Frontera, and came into water sufficiently shallow to call for a change from deep-sea to shore-end cable. Here the cable was cut and buoyed, about nine miles from Frontera beach. Released from the cable, the ship steamed at full speed to Frontera, and anchored near the mouth of the River Tabasco.

Here the Frontera cable house was landed and speedily erected on a suitable site near the beach and lighthouse. With a steam launch and lighters, two short diverging shore-ends were laid out from the cable house, and their sea-ends buoyed. The ship then picked up the western sea-end, spliced on heavy cable to it, and paid out to the Vera Cruz end buoy, nine miles out to sea. Reaching this buoy, the Vera Cruz end was picked up and found to be in good electrical condition. The cable paid out from the tank was then cut and spliced on to the Vera Cruz end, thus making the final splice and completing communication between Vera Cruz and Frontera, within thirteen days after first reaching Vera Cruz. The final tests of the cable, 234 nautical miles in length, were completed the same night from Frontera cable house.

After completing the shore-end of the Campeche section, by laying it out to sea for a distance of 8 miles from Frontera, the *Ydun* steamed directly to Campeche, in order to lay the cable from the port back towards Frontera and to make the final splice at the position of the shore-end buoy.

Campeche is a difficult port to enter with cable owing to the shallowness of its waters. When the *Ydun* anchored off the town in 15 feet of water at low tide, she was eight miles from the wharf, and was scarcely visible from the beach. In order to avoid anchors in an expanse where all is anchorage, it was necessary to lay the cable in a considerable detour. Added to this, there was no steam launch to be had in the port, the last existing one having blown up. There were also no lighters. In order to effect a landing, it was necessary to convert a sailing boat into a lighter by removing her mast, and to engage a schooner to act as tug. As the schooner could only tow the lighter when the wind was fair, it was necessary to await fair winds before towing the lighter inshore, or laying out seawards. However, by taking advantage of each change of wind, the cable house was landed and the shore-end buoyed seven miles out to sea at a position where the ship could reach it at high tide, within six days after reaching Campeche. On October 4 the ship spliced onto the shore-end and commenced paying out cable towards Frontera.

Up to that time the weather had been favorable, but on the following day a change set in for the worse. After about 120 miles had been paid out, it was blowing a gale and the ship could not keep her course. The cable was, therefore, cut and buoyed. Every hour brought more violent weather, until it was evident that the vessel was in a severe cyclone. In the early morning of October 7 the ship passed through the centre of the hurricane into a region of comparative calm wind but confused sea. Large numbers of land birds, varying in size from humming birds to large storks, alighted on the vessel at this time, having been caught in the centre of the hurricane and carried violently out to sea. After two hours' respite, the storm again struck the vessel from the opposite direction, and continued with violence for the day following. Although struggling against the wind with all the steam-power available, the steamer drifted very rapidly towards the shore. Fortunately the weather abated sufficiently when the ship was close to land to permit of the ship's holding her own, with both anchors out, and the engines going full ahead.

After laying at anchor for a day to let the storm go by, and to refit the ship, a run was made back to the position in which the cable had been cut and buoyed. The buoy, however, was nowhere to be discovered. Finally it was necessary to abandon further search for the buoy, and to grapple for the cable. A grapnel was put down, and the cable was hooked on the first drag. It was brought up to the surface on the afternoon of October 10, and the ship soon spliced it on to Campeche end. Paying out then recommenced. On the following day the buoy on the end of the heavy Frontera section was reached, and the final splice let go. This completed the laying of both cables within 38 days of the *Ydun* leaving New York Bay. On proceeding to Vera Cruz, the cable was taken over by the Mexican Federal Telegraph Department, and found to operate at a satisfactory hand speed by Morse system over the 450 miles from Campeche to Vera Cruz.

The entire engineering charge of the cable-laying expedition was given to Dr. A. E. Kennelly, Professor of Electrical Engineering at Harvard University, who also served as inspector for the Mexican Government during the manufacture of the cable. With him were associated on the ship the Safety Company's engineering staff, consisting of Mr. G. M. Haskell, chief electrician; Mr. Wm. H. Rodier, cable superintendent; Messrs. R. O. Smith and Thomas Bayne, assistant electricians, and Messrs. John Lind and Julius Bernstein, assistant engineers. The navigation and management of the ship were carried out by Captain C. Christiansen.

Meeting of the American Society of Mechanical Engineers.

At the meeting in New York City last week of the American Society of Mechanical Engineers almost a score of papers was presented, of which, however, but one had a direct relation to electrical engineering, read by Mr. Walter I. Schlecter and entitled "Fly-Wheel Capacity for Engine-Driven Alternators."

After outlining the principles governing the design of fly-wheels for engines driving alternators, and showing how the displacement angle for a given case may be determined by calculation or graphically, it is established that the limiting value of the displacement of phase in the electrical circuit is 2.5°, which corresponds to a cross-current of about 10 per cent. of the full-load current, and a torque equal to 10 per cent. tending to pull into step one of a pair of alternators in parallel. A formula is given for determining the weight of a fly-wheel which will limit the displacement to a value approximately equal to 2.5, the formula taking account of the various unbalancing factors and allowing a reasonable increase for overload. A table gives a comparison of the weights of fly-wheels on engines in a number of large plants, one column giving the actual, and another the calculated, weights. In some cases the fly-wheel is lighter, and in others heavier, than the weight which the calculations indicate as the correct weight.

"The Use of a Surveying Instrument in Machine Shop Practice" is the title of a paper presented by Mr. Charles C. Tyler, which describes methods for lining up large work by means of a dividing and levelling instrument similar to that used by surveyors. The method is explained with reference to its application to the machining of the 5,000-kw alternators built at the Westinghouse works for the New York Elevated Railway.

In a paper entitled "Rotary Pumps," Mr. John T. Wilkin described a pump of this type which he has designed. It is stated that rotary pumps of this kind have been made having capacities of 35,000, 40,000 and 50,000 gallons per minute, which are operating satisfactorily under heads of from 8 to 25 ft.; and that two plants are now under way, one consisting of four 35,000-gallon pumps direct-connected to Corliss compound condensing engines and to work under a head of 35 ft.; and the other two, 70,000-gallon pumps to work under a head of 10 ft. The efficiency as determined from indicator cards taken from engines operating rotary pumps has been found to range from 80 to 84 per cent.

A new oil-testing machine and some of its results was the subject of a paper by Mr. Albert Kingsbury. The apparatus was devised with especial reference to the conditions under which the effects of viscosity and those of body may be investigated independently of the effects of either.

The test journal has its axis vertical; it is suspended from the spindle by means of a flexible coupling and runs between two opposed bearings in a cylindrical cup or case, which may be filled with the oil to be tested if a "bath" is desired. The load on the bearings is provided, by means of a helical spring of 900 pounds capacity, with screw adjustment and with a device for quick application or removal of the load without disturbing the adjustment. This spring is en-

closed in a horizontal tube attached to the side of the oil case. The cup has a cover with a small hole for the insertion of a thermometer.

The cup and attached parts are borne on a hollow vertical spindle 1⅜ inches in diameter, turning freely in a sleeve supported from the frame of the machine; the spindle extends about two feet below the sleeve and is suspended from a fixed bracket by a tempered steel wire passing through the spindle to its lower end. In testing, these suspended parts turn freely to a position where the torsion of the suspension wire balances the friction at the test journal, and the angle of torsion, which may be as great as 270°, is read from a graduated disk. The suspended parts being counterbalanced, there is no appreciable pressure of the spindle against its sleeve; and when the oil in this bearing becomes evenly distributed, there is no error from friction. At the same time, the viscosity of the oil serves the purpose of damping the oscillations which arise from variations in speed or friction at the test journal. This mode of suspension gives large indications for very small frictions at the test journal, while a helical spring placed on the extension of the spindle is added for tests involving great friction.

For tests involving friction due to viscosity only, the test journal used is 1⅜ inches in diameter, running in two brasses, each having an arc of 120° and 2 inches long; while for comparing oils with respect to body or oiliness, the best results are obtained with a journal about ¼ inch in diameter running between two brass bearings 1 inch long.

The results of this method of testing for body show that the mineral oils as a class have much less body than the animal and vegetable oils. For example, in a body test of a mineral oil and a lard oil having viscosities 98.9 and 83.7 respectively, as determined by the Dudley pipette, the lard oil, although the less viscous, gives very decided evidence of greater body, by its much smaller friction. On the other hand, certain cylinder oils, wholly or largely mineral, and exceeding lard oil greatly in viscosity have also greater body than lard oil. The experiments showed that body is in some way related with viscosity, but that the relation must be quite different in the mineral and the fixed oils.

Mr. Frank Richards discussed in a paper the subject of gift propositions for paying workmen. He considers that the so-called "bonus" and "premium" plans both ignore the strictly business relation of employer and employee, though the latter is the better of the two; but that it is unfair in only giving the workman a half or a third of the price for the excess of work. It is his view that for everything a workman can do there is a fair and equitable price, whatever the difficulty of determining that price, and that when the man does the work he should get the price. The piece which by extra exertion he does last brings as much or more profit to the proprietor as the first piece that is done, and it does not appear why the man should not have his pay the same for each. No one can assert that the premium plan gives him this. It does not appear that the premium plan, or any other *gift* proposition, offers or suggests a permanent or satisfactory solution of the problem of equitably adjusting the wage to the work.

The lengthiest communications presented at the meeting were the final report of the committee appointed to standardize a system of testing steam engines, and a printed discussion of the same—the two occupying 133 pages of the *Transactions*. The report enters into the minute details of engine tests, giving instructions for all the different operations together with forms of record.

The "Metric System" was represented by a paper by Mr. F. A. Halsey, associate editor of the *American Machinist*, which opens with a statement of the overwhelming evidence lately given before Congress in favor of that system, followed by the expression, printed in italics, "It is up to us"—the application apparently being that the society should, by an adverse expression of opinion, overweigh such evidence. The arguments adduced against the system are principally those which the older generation of engineers have made familiar, accompanied by a running criticism of testimony given before the House Committee, and a collection of odds and ends gathered from the most heterogeneous sources and supposed to bear against the system. The paper concludes with a line in display type, "What are you going to do about it?" Many able engineers trained in the school of the past are sincerely opposed to the metric system, but we doubt if few of these will read this undignified presentation of their cause without wincing. The paper was followed by a lengthy discussion, one of the features of which was a sharp criticism of the paper by the editor of the *American Machinist*, with whom the author of the paper is associated editorially.

In view of the desperate fight of an element in the society has been making against the metric system, and also the manner in which this element was suppressed at the Boston meeting in the spring, it was expected that it would be represented in full force at the New York meeting. This appeared to be the case, but on a test vote a majority was arrayed against it.

The duodecimal system was advocated in a paper by Mr. Sidney A. Reeve, who proposed wiping out the numerical past and starting *de novo* with a system based on the dozen instead of the antiquated ten. 'He would add two new numerals, *dek* and *eln*, to follow ten, get even with that obnoxious word by rechristening it *doz*, and continue the warfare by changing the related teens to dos-two, dos-three, etc.; the twenties, etc., to twodz-one (21), fidze-one (51), etc. One section has for a head, "Think in Dozens," in which the statement is made, "The task in attaining familiarity with duodecimal numbers does not lie so much in learning the duodecimals as it does in forgetting the decimals." By this system the dollar would contain 12 bits of 8⅓ cents each, the bit 10 groats and the groat 10 grets. A reading of the paper leaves one in a quandary as to whether it was written in all seriousness, or intended to be taken as a satire on the metric system, or was perpetrated as a practical joke on the Society of Mechanical Engineers.

Lighting the St. Louis Exposition.

Mr. Henry Rustin, chief electrical and mechanical engineer of the St. Louis Exposition, in a memorandum on the subject of lighting, remarks:

The results which can be accomplished by artistic arrangement of lights are numerous, and additional possibilities are created by combining lighting with fountain displays. The vista, as seen from the north end of the main court, will be closed by the Cascades in front of Festival Hall; here all efforts will unite for creating a maximum spectacular effect in architectural gardening, fountain display and light. At night the scene on the main court will be an effect which, for lack of a better term, may be called nocturnal architecture; in that the placing of myriads of points of light, in outlining the structures, in face-lighting entire surfaces, or in accentuating prominent architectural features, will produce an appearance in the structures that is entirely different from the daylight scene. This effect, achieved in milder manner at the entrance to the Grand Court, will lead with ever-increasing intensity up to the main effect at the Cascades. The general style of architecture adopted by the Exposition presents unusual opportunities for display lighting. The color of the buildings is, in the main, white and the full value of each lighting unit is reflected.

Much attention is being given the question of supports for lighting about the grounds to prevent their being obtrusive. It is a difficult matter to provide the necessary amount of lighting for walks and avenues without accumulating a forest of lamp posts. Arrangements have been perfected, however, in which it is only necessary to place a few posts at long intervals, and, at the same time, keep the unit of illumination of small candle-power.

The scheme adopted leaves the vista almost entirely free from any obstructions to the sight. A certain amount of illumination will be placed on posts about the waterways in order to take care of the traffic of small boats. These lights, however, will be kept very low.

While decorative illumination will be general throughout the grounds, certain portions will be featured, to a greater extent than has been possible at previous expositions. The portions which will receive particular attention will be the avenue leading towards the Government Building and the Government Building itself. This structure rises to considerable prominence in that it is situated on a high hill. The chief display, however, will be made in front of Festival Hall, covering the entire territory known as the Cascades. This will be a stretch of artistic architectural and landscape composition something over a thousand feet in width and over five hundred feet in depth, and at three different points immense cascades of water will tumble down, making a total plunge of one hundred feet.

As arranged, this Cascade at night will be saturated with light of varying colors, and the entire surroundings of architecture and foliage will be bathed in the same shades of color as the water effects. This will not be accomplished by means of stage lights or

searchlight effects, but will be produced on the structures themselves as if they had each become light-giving.

The Exposition has provided itself with facilities for the supplying of an immense amount of electrical energy. This will be distributed in the usual manner to the several points of consumption; the major portion of this energy has been apportioned to the producing of a picture in light.

An ample portion of electrical energy has been apportioned for the use of the exhibitor, the concessionaire and for the Foreign and State Buildings section; the total of the electrical service so apportioned is considerable, and in variety includes service for every known commercial electrical work, such as charging current for batteries, current for series alternating, and direct-current arc lamps, current for all varieties of direct and alternating-current motors, service for multiple direct-current and alternating-current arc lamps. This latter service presents quite a variety of alternating-current voltages and frequencies, as well as a good variety of direct-current voltages.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

SEPARATION OF NICKEL AND COPPER.

The Canadian Copper Company, of Cleveland, as the assignee of Mr. David H. Browne, has secured control of one of the simplest cyclical methods yet offered for the electrolytic separation of copper and nickel from their alloys. The alloy, substantially freed from sulphur, is in part granulated and in part cast into anodes, the proportions so treated depending upon the composition of the material. The granulated portion is then subjected, in a leaching tower, to the simultaneous action of free chlorine and a solvent for cuprous chloride. The solvent, preferably brine, is flooded continuously over the alloy, and by removal of the cuprous salt exposes fresh surfaces of the alloy to the action of the chlorine.

The resulting solution of cuprous and nickel chlorides in sodium chloride is then electrolyzed with anodes of copper-nickel alloy, whereby copper is plated out at the cathode, and the solution becomes enriched in nickel. It is stated that *all* of the copper may be plated from the solution under these conditions—a seeming inadvertence, since copper-bearing anodes are used. Finally, this nickel-bearing solution, after purification and concentration, is electrolyzed at moderate temperatures with insoluble anodes, for recovery of the metal, the evolved chlorine being conducted to the leaching tower.

TREATMENT OF GOLD-BEARING SOLUTIONS.

Three distinct electrolytic methods have been used for the precipitation of gold from cyanide solutions. The first depends upon local currents between the constituent metals of an alloy composed of zinc and lead, or zinc and other metal far removed in the electromotive series; the second, upon local currents between fragments of zinc and carbon or between fragments of zinc and carbon plates; and the third upon electrolytic action instituted and controlled by current from an outside source, as for instance in the Siemens-Halske method employing anode plates of iron and cathodes of lead, the latter either in plate form or sub-divided by turning or otherwise.

Patents recently issued to Sidney T. Muffly, of Bowdre, Ga., cover, as process and apparatus, an odd combination of these three known methods. An alloy of zinc and lead in proportions of 80 parts zinc to 20 of lead, in the form of turnings, is used in conjunction with plates of porous carbon—the galvanic couple so formed being given the form of a filter for the gold-bearing solutions. In addition, this entire element, both alloy and carbon, is made the cathode of an external circuit. As a further feature warm air is injected into the filter bed.

The patent description belongs to the too familiar class which asserts but does not explain. Thus the advantages of the arrangement are said to be "a perfect and constant polarization of the compound molecules of solution," "a polarization of the solution," and "an abundant amount of oxygen to enable the molecules of the solution to more rapidly exchange their atoms." As a whole, its perusal is not profitable.

In general, however, it may be said of the method that the controlling elements in the separation of gold are well understood; that cathode surface and current density control here as elsewhere, and that the proper conditions can be secured with less complication of parts than in this system.

Independent Telephony in New York State.

Mr. B. G. Hubbell, president of the Consolidated Telephone Company and of the Inter-Ocean Telephone and Telegraph Company, was interviewed recently in Elmira, N. Y., as to the results of independent work. After recapitulating what had been done in Grand Rapids, Toledo, Rochester and other cities, he said: "New York has been the last State to take up the independent telephone development. During the last two years, however, many millions of dollars have been invested in this State in the independent telephone business. To-day there is hardly a city, town or village in this State that does not have an independent telephone system, either in operation or under construction. I think I am safe in saying that the independent telephone business is one of the most active enterprises in the State to-day in respect to the capital being invested for extensions. The Inter-Ocean Telephone & Telegraph Company has many hundreds of men at work in all parts of Central and Western New York, building long-distance lines to connect the independent exchanges in all cities and towns in that section. There are over 30,000 telephones operated by independent companies in Central and Western New York that will be soon connected in a large and comprehensive long-distance service. I think I am safe in saying that within a year from to-day the independent companies will give a subscriber very many more telephonic connections in Central and Western New York than can be gotten from competing telephone lines. The prominent business men of this section are investing heavily in independent telephone securities. In each community in which these companies operate a financial following has been obtained that will give the independent telephone companies a permanency in its business that will be greatly to its financial benefit. The independent telephone business is not, strictly speaking, a competitor to the Bell company. In towns where the Bell company has operated for fifteen to twenty years and has been able to secure not more than 200 or 300 subscribers, the independent interests within a year or two are able to secure 800 to 1,000 subscribers. There are, therefore, some 600 to 800 telephone users in these towns who have never before had a telephone, and with whom the Bell Telephone Company has never dealt. There is enough of this new business to support the independent interests without interfering with the Bell subscribers, and without entering into competition in any way with the Bell company for that particular business. The telephone business is so active, there is such a tremendous demand for telephone service, that no one company can expect to serve the entire needs of the public. If the Bell company had been able to serve the public's needs there would not have been this universal and successful competition."

New Equipment for the Study of Illumination.

In view of the recent discussion with regard to the relative value of candle-power and illumination measurement, brought out by the advent of the Nernst and other new forms of lamps, the following description of an equipment for the study of illumination now being installed in the electrical engineering department of the Ohio State University, may prove interesting.

A frame about 14 by 8½ ft. is suspended by pulleys to the ceiling, so that it can be raised to the height of 10 ft. from the floor, and around the under side of this are placed two lines of ordinary window shade rollers; upon the inner line of these rollers are hung curtains of black cheesecloth, and upon the outer, curtains of some suitable white cloth. Upon the upper side of the frame are placed upon opposite sides similar lines of rollers, the one with the black and the other with the white cloth.

By this means it is possible to change from a room in which there will be practically no reflection to one of the same size, in which the reflection will be a maximum, and this without changing any of the other conditions of the room.

In this way the comparative value of any two different kinds of illuminant or of different sorts of shades or reflectors, can be determined both for conditions of highly reflecting walls and non-reflecting walls. It will also be possible to easily replace one or both of these sets of rollers with rollers covered with cloths of different colors. Again by using the white curtains alone, the effect of a room with dark walls and a light ceiling can be studied; or by using two adjacent white walls and the white ceiling, the conditions in the corner of a large room can be approximated.

This arrangement is also particularly adapted for carrying out Mr. C. F. Scott's suggestion for the study of illumination by comparison of two entirely similar rooms lighted with different illuminants. This will be accomplished by putting a piece across the middle of the room and hanging shades upon it, similar to those forming the walls and ceiling; there will thus be two rooms about 7 by 8½ ft., which will be exactly similar in all respects, and which can further be transformed from light to dark or from dark to light walls at will. By changing the height of the frame, it is also possible to study the effect of height of ceiling.

It would unquestionably be desirable to have this room larger, but all the space at present available has been utilized. It is hoped, however, that in the future a larger space may be obtained.

New Telephone Patents.

Almost since the days when the bridging bell first rendered party lines satisfactorily operative, inventors have attempted to improve upon this system, having in view two specific results—first, the elimination of the code ringing, and second the provision of a secrecy device. One of the four telephone patents of the patent issue of December 2 refers to such a party-line system, it being that numbered 714,759, covering improvements in the system originally specified and claimed in patent 609,173 of August 16th, 1898, issued to the same inventor, Mr. A. F. Swan, of Bayonne, N. J. As the substance of the original invention and that under present consideration are essentially involved, the system in its present status will be described as a whole, irrespective of the limits of the two patents.

In Fig. 1 is shown two of the subscribers' stations of a three-party line, the apparatus being so disposed that the circuits may be readily drawn. In the lower part of the figure are developments of the selective drums at the three stations.

Referring to the circuit, *26a* is an electro-magnet in series with the line. This magnet has associated with it an armature, *26*, and this, through an escapement to which it is linked, serves to rotate the selective drum *11*. Disposed around the drum are the radial pins *13*, engaging a cam contact lever *16*. Normally the drums at all stations are in such a position that the pin engaging the contact arm has forced this latter to the extreme right, so that the contact *18* is closed at each station. The circuit may then be traced through each station, involving successively the contact cam *14*, the push switch *37*

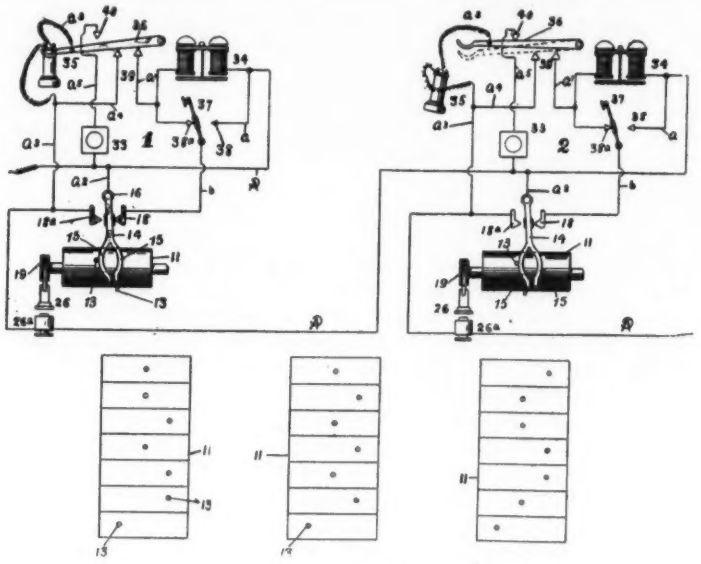


FIG. 1.—SWAN TELEPHONE SYSTEM.

and the hook switch *36*. When the selective drums are turned one step, the contact cam at station 1 is held midway between contacts *18* and *18a*, while those at stations 2 and 3 are thrown to the left against the contact *18a*. Thus stations 2 and 3 are short-circuited from the line. Similarly the second position of the selective drums cuts out stations 1 and 3, and the third cuts out 2 and 3. By a different arrangement of the pins steps are provided so that 1 and 2 may use the line to the exclusion of 3; 1 and 3 to the exclusion of 2; and 2 and 3 to the exclusion of 1. These steps are clearly indicated in the developments.

There are several points about this system which would apparently weigh heavily against it in practical working. For example, the work of the central office operator would be greatly increased, for much time would be required to step along the drums and then, after conversation, to return them to zero. Again, the system is a series one and not only would it be difficult to overcome inductive disturbances, but the impedance of the operating electro-magnets would greatly affect the efficiency of the lines. Finally, the operating electro-magnets must necessarily be adjusted to limits—that is, must not respond to the ringing current nor to that feeding the transmitters, but they must respond to the selective current.

A second of the patents of this issue is entitled "Joint for Telephone Transmitter Arms," granted to C. T. Mason. The invention consists in the substitution of a cone-bearing clamping device for adjusting the angle of the transmitter, to replace the present almost

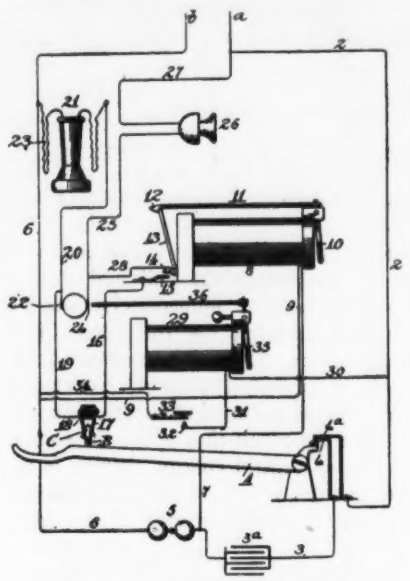


FIG. 2.—EGAN PAY TELEPHONE.

universal design where the clamping nut must deflect the wings of the transmitter holder in order to secure the pivoted transmitter arm. This new clamp not only permits of easy adjustment of the transmitter, but also saves considerably in the cost of manufacture, as no contact is required between the wings of the support and the transmitter arm, and consequently these parts do not have to be accurately fitted.

Both of the remaining telephone patents are issued to one inventor, C. E. Egan, of Durham, N. C. The first of these covers a "pay telephone," being a slot pay-station apparatus having a coin ejector; while the second describes a novel form of polarized bell.

In the pay-station device provision is made for receiving calls at all times, for making calls on the deposit of the proper coin in the slot, and for the return of the coin in case the call, for any reason, fails. The circuit of this pay station is shown in Fig. 2. When a call is received, the current for the polarized bell divides between the drop *8* and the bell *5*. This causes the drop shutter to fall, closing the contact *15*. On the other hand, when the call is answered the rising receiver hook closes contacts *17*, *18*, thereby completing the talking circuit. When the receiver is returned to the hook the drop shutter is automatically returned to the vertical position, opening the contact *15*. As this drop relay is enclosed in the case of the instrument, it is not possible to operate it by hand. Neither can it be operated by the condenser discharge, for as soon as the hook switch raises, the condenser circuit is broken at the contact *4*. Now, when it is desired to make a call from the station, the receiver is raised from the hook, and the hook switch ascending closes the lower end of the coin slot in such a manner that the coin in its fall will be retained in the slot between and complete the electrical circuit of the springs *25*, *26*. Thus, the circuit of the transmitter and receiver is completed.

Upon the return of the telephone to the hook, the coin is deposited or returned, according as the call was completed or not, the ultimate course of the coin being under the control of the central office operator through the agency of the electro-magnet *29*, which serves to switch the coin into the proper slot.

The principle of Mr. Egan's ringer is well shown by Fig. 3,

wherein one leg of the double iron core *c* is provided with the usual wire helix, while the other carries a condenser *x*. This condenser is formed by rolling up alternate sheets of foil and insulating material. The armature of the bell carries in addition to the hammer, two springs, one designed to close a contact at *d* and the other to give a

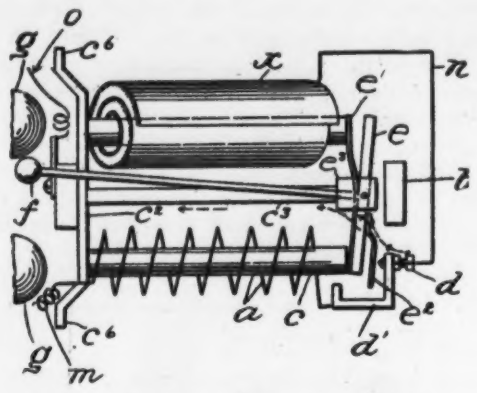


FIG. 3.—EGAN TELEPHONE SIGNAL BELL.

permanent bias to the armature, so that it will always come to rest in the same position.

The action of the bell is as follows: When an impulse of the proper direction passes through the coil and into the condenser, the armature responds almost immediately, short-circuiting the condenser and thereby allowing the full force of the current to be spent in the magnet coil. Upon the reversal of the current with the next impulse, the same action takes place except that the stroke is begun with the condenser cut out and completed with the condenser cut in. Thus we have the result that while the condenser, required on account of the use of central energy signals, is normally in the bell circuit, it is cut out the major portion of the time of actual operation of the bell, resulting in a louder and better ringing.

CURRENT NEWS AND NOTES.

MEETING OF UNDERWRITERS' ASSOCIATION.—The Underwriters' International Electric Association has been in session during the week in New York, and at well-attended meetings has under discussion a number of topics, including interior conduits, switch-boxes, high-voltage circuits, etc., as well as the reports of committees and other business.

NEW YORK ELECTRICAL SOCIETY.—In spite of the inclement weather on November 25, Mr. A. Frederick Collins's interesting lecture on "Wireless Telegraphy" brought out a large audience of members of the New York Electrical Society, at the room of the American Institute. The next subject to be discussed by the society is one most attractive to those interested in improvements in machine shop equipment. On Wednesday, December 17, Mr. Charles Day, of the engineering firm of Dodge & Day, Nicetown, Philadelphia, Pa., will lecture on "The Requirements of Machine Tool Operation," with special reference to the motor drive.

SYNTONIC WIRELESS TELEGRAPH SYSTEM.—Five patents granted December 2 to John S. Stone, of Boston, relate to a wireless telegraph system in which the sending and receiving stations are tuned to a given frequency. At the sending station a resonant circuit is in inductive relation on the one side with the antennæ, and on the other side with the usual induction coil key circuit. The receiving station on similar circuit is in similar inductive relation with the antennæ and with the coherer circuit. If the capacity and inductance of the resonant circuit at the receiving station be properly proportioned to those of the sending station, the former will respond only to signals sent out by the latter. If there are a number of sending stations with different resonant circuits, a receiving station can adjust its resonant circuit to respond to any one of these.

CORNELL CLUB IN LONDON.—A cable dispatch from London of December 6 says: The first American university club in England was organized to-night at a dinner in the Trocadero restaurant. It is composed of graduates of Cornell University and is named the Cornell Club. It starts out with a membership of forty. It is significant of the practical value of American training that nearly all the members of the club are permanently engaged in London in mechanical, electrical and engineering work. The president is Oliver Shiras, who is with the Westinghouse company. The vice-president is Charles Spofford, a director of the District Railway. The secretary is S. B. Fortenbaugh. The directors are E. A. Carolin, of the General Electric Company; W. C. White, of the White Automobile Company, and F. H. Fayant. The club will take a prominent part in the reception and entertainment of the Cornell crew if it comes to Henley for the annual regatta.

ELECTRIC STEERING GEAR.—Two patents on systems of motor control for electric steering gear were granted recently, one to Harold W. Buck and the other to Maxwell W. Day. In the former a pilot motor is employed to control the circuits of the steering motor, and in turn is controlled by a switching arrangement operated conjunctively from both the steering wheel and rudder. A multiplicity of wires form a rheostatic arrangement geared to the rudder head connected with an electro-magnetic device, the function of which is to act on the switch controlling the pilot motor, which switch is geared to the steering wheel, in a manner opposite to the action imparted by the steering wheel; that is, a motion of the switch in one direction following a movement of the steering wheel, is immediately counteracted by the rudder head and electro-magnetic mechanism. The Day patent relates to a modification of the same invention, the pilot motor with its rheostatic control of the rudder motor being replaced by the Ward Leonard system of control.

FESSENDEN SYSTEM OF WIRELESS TELEGRAPHY.—Two patents were granted December 2 to Prof. Reginald A. Fessenden, one on a method of multiple and multiplex selective signalling by electro-magnetic waves, and another on a current-operated receiver for electro-magnetic waves. In the form of receiver described, a slowly rotating magnetic field produces a slowly rotating magnetic flux; the field and flux are constant in amount, but the flux lags normally behind the field. A winding connected inductively to the antennæ on the one hand, and in relation with the rotating field on the other hand, receives the current due to signal waves, the passage of which current reduces the above-mentioned lag; this variation of lag between the direction of the flux and the field generates a voltage which is used to produce an indication. The primary of the transmitting induction coil contains two or more make-and-break mechanisms which can be independently operated at predetermined but different rates. At the receiving station are two or more wave-responsive devices in circuits tuned to the periods of the transmitting make-and-break mechanisms.

THURY 25,000-VOLT, DIRECT-CURRENT DYNAMO.—Our Paris correspondent sends us the following additional information relating to the 25,000-volt Thury direct-current dynamo used with the St. Maurice-Lausanne transmission plant described in our issue of October 25. The armature is stationary, the revolving part being a bipolar field magnet, which is separately excited. The armature has a 48-coil Gramme winding, each coil having 500 turns of 0.2 sq mm wire, the armature resistance being 700 ohms. The slots are 1 in. deep and ¾ in. wide, and the bore of the armature is 24 in. The external diameter of the armature core is 40 in. and the width of the armature 12 in. The machine will generate 1 ampere at 23,000 volts. The most interesting part of the machine is, of course, the commutator, the sections of which are separated by air insulation. As the pressure between the commutator segments may be as high as 750 volts momentarily, means of avoiding sparking are essential. An air blast to blow out the sparks is produced by a fan mounted on the main shaft of the machine. By this arrangement the blast is stronger the faster the speed of the machine—i. e., the higher the voltage. In addition to this, condensers are connected between adjacent sections. There are 96 commutator segments, so that the difference of potential between each is 500 volts. It is found that the air blast is only needed when the current exceeds 0.3 ampere. The current is collected by brushes which rotate with the field magnets and are connected to two highly insulated slip rings.

NOBEL PRIZES.—A dispatch from Stockholm, Sweden, dated last Sunday, stated that Nobel prizes were to be distributed on Wednesday of this week, as follows: Professors Lorenz and Zeeman were to divide the physics prize; Prof. Emil Fischer, of Berlin, was to receive the chemistry prize; Prof. Mommsen, the literary prize; Major Ross, of Liverpool, the medical prize, and Prof. De Martens, the peace prize. This announcement is at variance with the first dispatch cabled to this country and which was noted in our issue of last week.

ADVANTAGEOUS STRIKES.—In speaking of the possibility of labor troubles in the West, a high railroad official said that there was not the slightest possibility of strikes there. Continuing, he expressed the following opinion of the present system of train orders: An occasional strike by the telegraphers I sometimes believe is a good thing. It teaches the trainmen what they can do without orders, and leads to reform of the present system of a useless multiplicity of train orders. The railroads are practically all equipped with the block signal system now where there is danger of collision, and I believe that it would be just about as well to do away with the elaborate train order system now in use. Each train could then be run upon its rights. There could be no mistakes in the interpretation of train orders, and the men in charge of trains would feel their responsibility more, and follow rules absolutely.

WESTON INSTRUMENT PATENT DECISION.—Judge Coxe, of the United States Circuit Court of the Southern District of New York, has handed down a decision in an infringement suit instituted by the Weston Electrical Instrument Company, which sustains in unequivocal terms two Weston patents on alternating-current instruments, one being a reissue patent dated June 28, 1892, the date of the original application being January 18, 1890; and the other a patent subsidiary to this dated March 8, 1892. The defenses with respect to the earlier patent were lack of patentability, non-infringement and invalidity of the reissue; and lack of invention and abandonment with respect to the later patent—all of which points were decided in favor of the complainant. Judge Coxe held that Weston was the first to make a successful commercial voltmeter for measuring alternating currents, and this his device is to-day recognized as the standard instrument. There was, strictly speaking, no prior art, no practical commercial instruments prior to Weston's, and none entitled to be considered as anticipations. The Kelvin balance, Siemens dynamometer and Cardew hot-wire voltmeter were dismissed, the first-mentioned as being merely a laboratory instrument, the second as a complicated and sensitive device having the same fault, and the third as defective, inaccurate and liable to get out of order. While there were other instruments, they have since been relegated to the scrap heap of the art.

LETTER TO THE EDITORS.

Variable-Speed Motor Control.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the resumé in your issue of the 29th of November, 1902, of the various papers and the discussion on variable-speed control, at the November meeting of the American Institute of Electrical Engineers.

The subject considered is one of considerable interest and importance and one on which a large amount of time and ingenuity has been applied with more or less success. I desire to call attention to one method of variable-speed control, which seems to be entirely overlooked by those engaged in discussing this subject, and one which to me appears to be the only method which most nearly fulfills all the requirements of variable electric speed control.

It may be stated generally that the best method of speed control is that one which gives the widest range of speed change at the highest efficiency with the greatest simplicity of mechanism and at the least first cost. All of the methods enumerated and discussed in the various papers presented appear to fail to meet these requirements in one or more particulars, as do also several other methods not mentioned. Particularly is this so as regards efficiency and simplicity.

President Scott said "That the speed of a direct-current motor depends upon the number of turns in series on its armature, the strength of its field and e.m.f. applied to its armature. In practice speed changes are effected by varying one of these three conditions or by combinations of them." The method of speed regulation to which I desire to call attention is a form of field regulation, but not in the sense in which this is generally understood.

The accepted method of field regulation and one of the methods of variable-speed control most used, consists in varying the resistance of the field magnet windings by the introduction into or withdrawal from the field circuit of more or less of a highly resistant wire or other conductive material, and by so doing varying the strength of the magnetizing current and thus the strength of the magnetic field.

This method is limited in range of speed variation and not of the highest efficiency, although simple in form and of low first cost. Only about 40 per cent. advance in speed is permissible before the field strength becomes so weak and the sparking at the commutator so great that the motor is in danger of being seriously injured or destroyed. The power output of the motor is also very materially reduced as the field is weakened. This method is also step-by-step and not gradual in its operation.

There is another way in which the strength of the magnetic field can be varied which is almost entirely free from all these objections. Quite a large range of speed variation, from 65 per cent. to 120 or 130 per cent. advance in speed is attainable, at the highest efficiency at all rates from the lowest to the highest speeds, in a very simple manner and at a low first cost. The motor gives a constant brake horse-power at all speeds, there is no sparking at the commutator at any speed and the method is so gradual and even in its operation that any speed from the lowest to the highest, to a fraction of a revolution can be obtained as desired.

I refer to the method of changing the reluctance of the magnetic circuit by increasing or diminishing the amount of magnetizable material in this circuit, and so increasing or diminishing the strength of the magnetic field that the magnetizing current remaining constant at all times.

A motor of this type does not differ materially in its make-up from the ordinary motor, except as regards its polar construction. One of the poles comprises a pole shoe of common form, integrally connected with a cylindrical shell, over which the magnetizing coil is wound, and within which is a solid core of high permeability and of a cross-section relatively large as compared with the conducting area of the enclosing shell. By means of a hand wheel this inner core or "plunger" is adjustable in a direction radial to the center of the armature, and is so proportioned that a slight variation in its position within the magnetized shell produces a very considerable difference in the reluctance of the magnetic circuit of which the plunger forms a part.

When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of a minimum reluctance, and, since the m.m.f. of the field coil remains constant, the volume of magnetic flux becomes a maximum and the speed a minimum, or normal. As the plunger is drawn away from contact with the pole shoe a column of air is interposed which gradually increases the reluctance of the magnetic circuit as long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion the reluctance of the magnetic circuit, and hence the speed becomes maximum.

It will thus be seen that the air-gap between the polar face and the armature always remains fixed and constant, the air-gap inside the pole being the element which is varied; and that as the magnetic flux is diminished by the outward movement of the plunger, the remaining magnetic flux is forced more and more in the direction of the pole tips, thus furnishing a magnetic field at all times of sufficient intensity to insure sparkless commutation.

To those familiar with the action of field-regulated shunt motors of ordinary type, a variation in speed of 100 per cent. by a corresponding variation of the magnetic flux would seem impossible of realization on account of the difficulty of securing sparkless commutation when the field strength of the motor is so abnormally reduced, but in the type here considered these objections are overcome, and the motor operates sparklessly under very wide variations of speed.

In regard to the fineness of speed adjustment, it is evident from the principles of the machine that there is no speed between maximum and minimum which cannot be obtained by an appropriate adjustment of the hand-wheel. It should be understood that while the motor carries its full load sparklessly, at any imaginable speed within its range at practically maximum efficiency, it will also carry any

lesser load with a consumption of power corresponding with the actual work done. As the speed regulation is effected solely by varying the reluctance of the magnetic circuit no controller or rheostat or resistance of any kind is used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed.

This method of variable-speed control is susceptible of other arrangements and variations, but the principle involved, that of varying the reluctance of the magnetic circuit by varying the amount of magnetizable material in such a circuit, gives a very wide range of speed change, at high efficiency, in a very simple manner and at low first cost; and also enables the motor to carry its full load without sparking, at any desired speed within its range, with an efficiency practically as high at one speed as at any other, and this without the use of any controller or rheostat whatever. It would therefore seem that this method is one which most nearly fulfills all the requirements of variable electric speed control.

New York. E. R. Knowles.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Variable Speed Three-Phase Motors.—Behn-Eschenburg.—An illustrated description of induction motors built by the Oerlikon Company for changing the speed. The method consists in a combination of windings that can be grouped alternately so as to give either one number or double that number of poles, with the arrangement of two sets of independent windings having different numbers of poles. Thus, if one winding is arranged for grouping to give either 12 or 6 poles, and the other to give 8 or 4 poles, speeds corresponding to 12, 8, 6 or 4 poles will be available. In the first variable speed induction motors of this company the Gramme ring inducing winding is used, while in recent years drum windings have been employed. The winding has symmetrically arranged coils, as in the case of a direct-current armature, and is divided into 6 p groups of coils, p being the smallest number of pairs of poles employed. These groups of coils are changed over from p pairs to 2 p pairs of poles by a change-over switch, every two groups of coils belonging to one-phase being coupled in parallel for p pairs of poles, and in series for 2 p pairs of poles. For motors whose torque can be lower at high speed than at low speed, another variation is possible by changing from star connection to mesh connection, which gives a lower torque with good efficiency and power factor. The change-over switch itself is a combination of two ordinary three-pole switches. The small number of leads and terminals in combination with the simple, easily inspected winding, similar in every way to the winding of a direct-current armature, is said to form the principal point of novelty in the system. A considerable economy can be obtained by changing the poles in the case of three-phase motors which have to be started and stopped often, as in haulage or traction motors; on such machines the power expended in starting is of considerable importance; by increasing the number of poles while starting, the power lost in starting resistance in the induced winding, for a given torque, can be reduced to a quarter or half the original value, according as the number of poles at starting is four times or twice as large as the normal. The economy of starting can in this way be made equal to that of the series-parallel control of direct-current motors, while at the same time using standard types of motors. The results of tests of a small motor of this type are given. The different numbers of poles used were 12, 8, 6, 4 respectively, with star connection in the first four cases and mesh connection in the last two cases; the number of revolutions was 500, 750, 1,000, 1,500, 1,000, 1,500; the load in hp 3.5, 4, 7, 8, 3.5, 4; the torque in kgm 5.5, 4.1, 5.2, 42.75, 2; efficiency at full load 72, 73, 85, 86, 86, 80 per cent.; efficiency at half load 70, 72, 82, 86, 82, 75 per cent.; power factor at full load 0.7, 0.82, 0.85, 0.92, 0.89, 0.92; power factor at half load 0.5, 0.65. 0.7, 0.83, 0.8, 0.88; no load current in amperes 11, 9, 8.5, 6, 2.8, 2; starting current 50, 50, 130, 135, 43, 45; heating after three hours' run at full load 50, 50, 40, 40, 35, 35° C. For a speed range of 1 to 2 these motors occupy the same space, have the same weight, the same output, the same efficiency and the same power factor as the standard single-speed motor, while for a 1 to 4 speed range the size and price increases only slightly. The author finally compares the speed variations obtained with these motors with those of modern direct-current shunt-wound motors; the chief difference is said to be that the three-phase motor works with approximately the same magnetic flux in the air-gap with all numbers of poles, and therefore can have a greater load and a better efficiency at the higher speeds, while the direct-current motor can only increase in speed through a reduction in the magnetic field, so that no increase in load or efficiency is possible.—Lond. *Elec.*, November 21.

Shaped Magnet Poles.—Davies.—An illustrated article on special shaped magnet poles and the way they affect commutation. To obtain a sparkless machine, several points should be attended to; first, the initial magnetic induction in the air gaps under the polar horns should be as high as possible, so as to afford a good reversing field; the way to do this is to reduce the polar arc to a certain proportion which gives the best results; the angle to be embraced by each pole-piece is usually made about 140° in a two-pole machine, about 68° in a four-pole machine, about 44° in a six-pole machine, and so on. Furthermore, it is essential that the cross-magnetization of the magnet pole-pieces brought about by the reaction of the armature on the field magnet, should be minimized as far as possible; for this cross-magnetization results in a weakening of the reversing field; this cross-magnetization may be prevented to some extent by increasing the reluctance of the path taken by the cross-magnetizing flux, which may be accomplished either by having a slot of moderate width cast in the magnet cores and pole-pieces, or by making the pole-pieces of cast iron. Another requirement is that the field in which the armature revolves must be magnetically rigid and not easily distorted, as otherwise every slight fluctuation of the load requires an alteration in the position of the brushes; there are several ways of modifying the shape and general design of the pole-pieces so as to impart a stiffness to the field; either the pole-pieces may be bored out so as to give a greater length of air gap at the tips of the poles than in the middle, so that the pole-pieces are non-concentric with the armature; or they may be bored out concentric with the armature in the usual way and the tips planed off afterwards; or the polar horns of opposite polarity are bridged across with a web of metal of the same kind as the pole-pieces, and of comparatively small section; or the pole-tips which are on one side of each pole only are made to point in the direction of rotation of the armature in dynamos and in the reverse direction in motors. A strong field is always desirable; yet if the field under the polar horns under which commutation takes place is too sharply defined, the neutral line on the commutator will also be sharply defined, and there will be a difficulty in setting the brushes so as to avoid sparking; to avoid this difficulty, each pole should have a fair amount of magnetic "fringing."—Lond. *Elec. Rev.*, November 14.

REFERENCE.

Armature Frames.—An illustrated description of riveted, wrought-iron, armature frames, introduced recently by Siemens & Halske for large alternators.—*Zeit. Ver. Dent. Ing.; Eng'ing News*, December 4.

Power.

Waterpower in Electrical Supply.—Adams.—An article in which he first discusses the variations which may be expected in the capacity of a water power during the several months of a year; curves from actual practice are given. He then deals with the case in which the total daily flow of water is equal in capacity to the total daily output of electrical energy, and discusses how far the water power can then be devoted to the development of that energy; this of course requires storage either of water or of electrical energy in storage batteries. He finally discusses what percentage of the yearly output of energy can be derived from water where this power is sufficient

to carry the entire load during a part of the year; he points out the different factors which must then be considered, and from an example in actual practice he concludes that comparatively large variations are to be expected in the value of the energy developed by water power in per cents of the total output of electric supply systems in different half years; but, in spite of these variations, the portion of electrical loads that may be carried by water power is sufficient to warrant its rapidly extending application to lighting and power in cities and towns.—*Cassier's Mag.*, December.

Electricity from Refuse.—GOODRICH.—An abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. on "Electricity from Refuse; the Case for the Modern Destructor." He said that immense strides have been made in the last fifteen years. Continuity of high temperature is the essential for securing steady steaming, and in designing a destructor, combined with an electric plant, this is the cardinal point to be borne in mind. After quoting Highfield's advocacy of erecting cells in pairs so that one should always be working at its maximum, while the other is being charged and clinkered, he advocated as an excellent way of obtaining steady steaming and complete combination, the Mestrum system of continuous grate with divided ash pits; this is described and illustrated. Statistical data are given from 160 destructor plants in Great Britain and Ireland, 45 of which are in combination with electricity works. He says that efficient data are available to show that with a well-designed and well-managed plant at least "30 units per ton of refuse" burned may safely be relied upon throughout the whole year. Though continuous destruction of refuse is more economical and satisfactory; yet he thinks that the gain from the utilization of the power for lighting purposes quite justifies keeping it back and burning it only during the hours of electric lighting.—Lond. *Elec. Times*, November 20.

REFERENCES.

Turbines.—THURSO.—A very long and profusely illustrated article on modern turbine practice and the development of water powers. He first discusses the development of the turbine, and then the present American turbine practice with some remarks on the causes of lack of progress among American turbine builders. He finally takes up the modern turbine types and their construction in general, including turbines for low heads, medium heads, and high heads.—*Eng'ing News*, December 4.

Hydro-electric Plants in the Alps.—DE LA BROSSE.—The third part of his serial. In this part he discusses various electro-chemical power houses; those in France are chiefly in the region of the Alps. He first gives a list of 17 power houses, of together 74,000 hp, a large portion producing calcium carbide, besides chlorates, aluminum and sodium. Some notes are added on various installations.—*Elec. Age*, December.

Electric Cranes.—WILLIAMS.—An article giving some notes on electric crane design and a wiring diagram showing the connections for a three-motor crane on a 220-volt circuit.—*Am. Mach.*, November 27.

TRACTION.

Electric Tramways.—C. AND B. HOPKINSON AND E. TALBOT.—A long abstract of a paper read before the (Brit.) Inst. Civ. Eng. The nature of the load on a tramway generating station is discussed and it is shown from actual records to what extent increasing the number of cars results in making the load more uniform. With 70 cars or more the load was so nearly constant that the steam consumption per unit was substantially the same as though it were constant and equal to the mean. Hence in a station of this size, equalization of the load by means of a storage battery is of no use as regards economy, though in a small station it may be of great value. A storage battery equal to replacing one-third of the generating plant for half an hour, should, however, be installed in a direct-current power station for the purpose of replacing a generating unit in case of break down and for running cars at night. The simplest method of transmitting the power to the cars is to make the trolley wires an electrically continuous network, and to feed the current into it at various points. In practice, however, it is found necessary to divide the trolley line into sections insulated from each other, each section being fed at one point. The points of division in the center of a city are determined by consideration of safety; in the outer districts, questions of economy and the necessity of keeping the variations of line-potential within limits, may enter. The principles were illustrated by reference to Newcastle-on-Tyne; there was no objection to the line-potential occasionally dropping 100 volts below normal; and this led to the result that a 2½-minute service of cars could be worked up to a distance of 2 miles from a feeding point. The most economical size of cable was next considered; the mean current density should rarely exceed 300 amperes to the square inch. This entailed a mean drop of potential of about 13 volts per mile of feeder, and feeders could be carried to a distance of 1 mile or 1½ miles without boosting. The loss in the trolley wire in supplying ten cars on 1 mile of double track from one end, was between 2 per cent. and 4 per cent. of the power given to the cars. The conclusion was that on the outer sections the line might be divided into sections 2 miles long. The most important requirements in a motor car for use in city tramway systems, are that it should be capable of rapid and well-sustained acceleration, and that it should be able to go up hill quickly. These requirements can be fulfilled only by motors capable of traveling on the level at speeds far above what is allowable in practice. Curves are given showing the acceleration of the car from rest with various motors and under various conditions. A mean acceleration of 3 feet per second up to a speed of 10 feet per second can be obtained with motors of a type found to be satisfactory in Leeds and Newcastle. The authors discuss at some length the problem of the return circuits.—Lond. *Eng'ing*, November 21.

Safety of Surface Contact Systems.—PAUL.—An article in which he criticizes the safety devices used in magnetic surface-contact systems. The cause of numerous accidents with the Diatto system in Paris has always been traced to the fact that the studs remained alive for a time after the cars had passed over them. As a means of safety in the Dolter system, both ends of the car are fitted with an earthed skate, which strikes each stud, short-circuiting it, should it have remained alive, the short circuit causing the fuse in the surface contact to melt. The author points out that such a contrivance interferes with the proper working of the system, and tends to reduce rather than to increase its safety as far as road traffic is concerned. Thus, supposing that a stud has remained alive and that the earthed skate strikes it, producing a short circuit, it does not follow that the fuse will melt; the time during which the earthed skate is over the stud is so very small that the fuse may fail to go, unless it be designed to blow with a very small current excess; in the latter case, however, it will be liable to go when the current is a high one, in starting a car for instance, or over heavy grade cuts. The proportioning of the fuses to meet all the conditions of working is a very difficult matter. Repeated trials have proved that fuses 10 by 1 mm in section proportioned for a fusing current of 60 amperes and a load current of 30 amperes, have not been blown when the short-circuiting skate has struck a stud that had remained alive. Moreover, supposing that the fuse in one of the contact boxes has melted, many days may often elapse before attention is called to the dead stud; the traffic may not suffer any interruption, but as soon as a car passes over such a stud, a break in the current always occurs at the neighboring stud, and this at the full intensity of the current which the car requires corresponding to its load; it means a cutting out of 30 to 40 amperes at 500 volts in the very small space which separates two contacts; the arc thus produced would have disastrous effects. Experience has shown that when a leakage occurs from the studs to the rails, the contacts in the apparatus open out only slowly, and sparking occurs owing to the residual magnetic flux. With low-current losses the magnetic blow-out will extinguish the arc, but the evil is not prevented from originating. When cutting out suddenly with the full car current the blow-out is not sufficient, and the arc will remain for some time if leakages exist on the street level. The author believes that, on the basis of the experience already gained, the only systems which meet the case are those with electro-magnetic surface contacts, containing perfect acting safety devices so arranged that the contacts are positively controlled and work sparklessly.—Lond. *Eng'ing*, November 21.

Electric Launches.—DREIHARDT.—An illustrated description of the electric launches exhibited at the International Self-propelled Boat Exposition at Wannsee, Berlin, 1902. Three electric launches were exhibited by the Accum. Fab. A. G. Hagen, which company is said to have installed 75 electric boats in the last five years. The number of cells in these boats is either 40 or 80, in order to be able to charge the battery directly from a 110 or 220-volt station; boats with 200 cells have sometimes been made for charging from 550-volt stations. The charging is nearly always done at constant voltage and variable current, which enables one to complete the charge more quickly and with less attendance. The controller is handled by the attendant at

the rudder. The largest of the three boats exhibited has a length of 19.5 meters, and is driven by a series-wound, 4-pole electric motor of 60 hp maximum, with 1,200 revolutions per minute; the weight of this motor is 1,000 kg. The battery contains 80 cells, each having 15 positive Planté and 16 negative Faure plates; the capacity is 450 ampere-hours for a six-hour discharge. The maximum charging current is 150 amperes, the maximum discharging current is 265 amperes. The total weight of the battery is 7,000 kg. The controller gives six different speeds; at the first three speeds the battery is connected in two groups in parallel; for the other three speeds all the cells are in series. The other speed variations are produced by connecting the four-magnet coils of the motor all in series, or in two groups connected in parallel, or all connected in parallel. The speed of the vessel varies between 9.5 and 17 km per hour. The two smaller vessels which were exhibited by the same company are also described.—*Centralblatt f. Accum.*, November 1, 15.

Installations, Systems and Appliances.

REFERENCE.

Central Station Statistics of Switzerland.—Lorenz.—A long article with map, giving essentially the same statistical data as the article abstracted in the Digest December 6. The map shows that nearly the whole northern and western parts of Switzerland are covered with a network of transmission lines and that only comparatively few lines are required to close all the meshes of this network. Many water powers are not yet utilized.—*Zeit. f. Elektrochemi*, October 30.

Electro-Physics and Magnetism.

Electrical Conductivity of Metals and their Vapors.—Strutt.—An account of experiments in which he tried to bridge over the enormous gap between the electric conductivity (specific) of liquid mercury and mercury vapor. Mercury vapor is an insulator, while liquid mercury is a conductor. Since the liquid and saturated vapor are indistinguishable above the critical temperature, one or both of these must undergo a remarkable change of electrical properties as that temperature is approached. Attempts to predict the critical temperature of mercury seem to lead to results altogether inconsistent with one another; attempts to observe the critical temperature of mercury and arsenic in quartz tubes, failed; in both cases the critical temperature lies above a dull yellow heat; up to a full red heat the conductivity of saturated mercury vapor remains of quite a different order of magnitude from that of the liquid, the latter being 10 million times as great as the former. But on the other hand, the conductivity of the saturated vapor is immensely greater than that of the vapor at atmospheric pressure; for the former was found to have a specific resistance of the 7th power of ten times that of the liquid, and the latter more than four times the 14th power of ten times that of the liquid. Thus the vapor at atmospheric pressure has a resistance about four times the 7th power of ten times that of the saturated vapor, both at a full red heat; this ratio is of quite a different order from the ratio of the densities of those vapors. It seems likely that as the critical temperature is approached the vapor begins to conduct freely, while the liquid changes its electrical character to a much less extent. The conductivity of saturated arsenic vapor at a bright red heat is of the same order as that of mercury, and obeys Ohm's law, at all events up to a voltage drop intensity of more than 100 volts per cm.—*Phil. Mag.*, November; abstracted in *Am. Jour. Sc.*, December.

Resistance of Lead Sulphide.—Van Aubel.—An account of measurements of the change of the resistance of lead sulphide with the temperature. While Streintz found that compressed galena powder diminishes in resistance as the temperature rises, thus behaving like an electrolyte, the present author observed the opposite behavior in a cylinder of fused lead sulphide, chemically pure. The resistivity diminishes constantly as the temperature is lowered down to the temperature of liquid air.—*Comptes Rendus*, November 3; abstracted in Lond. *Elec.*, November 21.

Conduction of Electricity in Flames.—Lenard.—A description of a phenomenon which he calls "visible wanderings of ions in flames." A Bunsen flame is placed in a horizontal electric field. If now a bead of some salt is brought into the flame, as for spectrum analysis, it is seen that the comet-shaped strip of luminous vapor runs slantingly towards the negative electrode. The "wandering" only sets in when the bead is brought into the interior of the flame. In the outer mantle the vapor ascends vertically.—*Ann. d. Phys.*, November 11, abstracted in Lond. *Elec.*, November 14.

Absorption of Electric Waves by Gases.—Lecher.—A description of an experiment which proves that the rings in an exhausted glass tube, produced by J. J. Thomson in an alternating electric field, are not due to electrostatic charge, but to an absorption of electric waves by the gas. The present author winds a bifilar wire coil and a simple wire coil round the same tube, and sends strong electric oscillations through both. In spite of the high charge of the wire in both cases, a ring is only formed inside the simple coil. He describes a method of studying the electrical conductivity of gases by observing the luminous phenomena thus produced. It consists practically of a vessel resembling a Bunsen ice calorimeter, the secondary coil being placed in the interior and the primary coil outside, with the gas or electrolyte in question filling the space between them. He finds that at a pressure of about 0.1 mm the air conducts much better than the best electrolytes. Such a pressure exists at a height of about 40 miles in the atmosphere, and it is therefore evident that the upper atmosphere very likely absorbs long Hertzian oscillations coming from the sun. It also explains the electric discharges often accompanying the fall of meteorites.—*Phys. Zeit.*, October 10; abstracted in Lond. *Elec.*, November 14.

Chemical Effects of Canal Rays.—G. C. Schmidt.—An account of an experimental investigation in which he endeavored to find whether positive ions in gases exert an oxidizing action. This might be expected, as the negative electrons in cathode rays are known to have a strong reducing effect, which has been explained by the assumption that the negative electron satisfies a positive valency of the metallic atom, so that this acquires a lower valency than before. By an argument based on analogy, it might be expected that canal rays, which are assumed to consist of positive ions associated in some way with neutral atoms, would exert an oxidizing action; the author did not, however, find any well-defined oxidizing action. There is powerful decomposition, but it depends upon the nature of the gas and the compound whether the decomposition results in an oxidation or in a reduction. Solid solutions which show luminescence under cathode rays show the same under canal rays, but it decreases rapidly owing to the decomposition, which is indicated "by the spectrum of the glow becoming whitish." If the gas in the tube is oxygen, and an oxidizable body is in it, the latter is oxidized; if, on the other hand, the gas is hydrogen, the latter reduces any compound capable of reduction. The most typical reaction for canal rays is the decomposition of sodium compounds; it takes place even when only traces of sodium are present, and is revealed by the *D* line.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 14.

Magnetization and Conductivity of Iron and Nickel.—Barlow.—An account of measurements of the change of resistance shown by ferro-magnetic metals on magnetization; he studied this property in iron and nickel. He gives an equation for the "fractional increase of resistance" in fields not exceeding 450 units; in strong fields varying from 1,000 to 11,000 units, the fractional increase of resistance for longitudinal magnetization in nickel wire is practically constant and equal to 0.017. In still higher fields this value decreases slowly to 0.010. The transverse effect also called the "longitudinal Hall effect" is negative in strong fields.—*Proc. Roy. Soc.*, October 17; abstracted in Lond. *Elec.*, November 21.

REFERENCES.

E. M. F. of a Thermocouple.—Ponsot.—A note in which he applies the thermo-dynamical principle to the theory of thermo-electricity.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 21.

Bismuth.—Lownds.—An account of an experimental investigation of the Hall effect, the ratio of the electric and thermal conductivities parallel and normal to the principal crystalline axis, and the change of the electric resistance of crystalline bismuth in a magnetic field.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 21.

Electro-Chemistry and Batteries.

Alkali Industry.—J. B. C. Kershaw.—The first part of an illustrated article on the present condition of the alkali industries. In the United Kingdom the capacity of two plants will be increased, and it is estimated that the output will then amount to 12,800 tons of bleaching powder and 18,000 tons of soda crystals per year. The Western Point works have paid a dividend of 6 per cent. for last year. Over 7,000 hp will soon be devoted to the electrolytic decomposition of salt in that country. Should the whole of the chlorine liberated

from the salt be converted into bleaching powder, the aggregate production of this chemical by the ton electrolytic plants will be about 25,000 tons yer year. In Germany, the group of electrolytic alkali works under the control of the "Elektron" appear to be working satisfactorily. The new Aussig "bell" process is being operated at one of the works, and it is probable that in course of time it will be generally adopted by all the works under that control. The maximum output of this group of works is 25,000 tons caustic potash and 40,000 tons bleaching powder per year; and the electrolytic works of the Solvaz Company, at Osternienberg, add about 5,000 tons to the latter total. The German home demand for bleaching powder is, therefore, more than covered by the output of the electrolytic plants, and the development of the export trade in bleaching powder is essential for the maintenance of the German electrolytic alkali industry. The total exports in 1900 amounted to 25,953 tons.—Lond. *Elec.*, November 14.

Explosion in a Storage Battery Plant.—SCHOOP.—An account of two serious accidents which recently happened in German storage battery plants, due to explosions on account of the use of electrically produced hydrogen and oxygen for soldering purposes. These gases are now said to be used for that purpose generally in German accumulator plants. The writer recommends excluding organic substances from contact with oxygen and to use water only for lubricating the valves, and to be very careful in holding the receptacles for oxygen and hydrogen particularly separate so that any mixture of gases by carelessness is excluded.—*Elek. Zeit.*, November 6.

Lead as Anode in Sodium Hydroxide Solutions.—ELBS AND FORSSELL.—An account of an experimental investigation of the behavior of lead as anode in sodium hydroxide solutions and of the electrolysis of sodium hydroxide solutions containing lead oxides. The principal results are as follows: A lead anode dissolves in sodium hydroxide. In the electrolysis of sodium hydroxide solutions, containing lead oxides with inert anode, the primary electrolytic action at the anode is the discharge of lead oxide and oxygen, while lead peroxide is secondarily formed; hence the amount of peroxide formed per coulomb increases considerably with increasing temperature; moreover the speed of formation of the lead peroxide depends greatly on the material of the anode. Lead peroxide has, like platinum and some other metals, the property to occlude oxygen. —*Zeit. f. Elektrochemie*, October 2.

Reduction by Calcium Carbide.—NEUMANN AND VON KNEGELGEN. —Two articles of a polemic nature. It is known that calcium carbide may be used for the reduction of metallic oxides and salts. These two authors have reached different conclusions concerning the formula representing the process; von Knegelgen's formula requires considerably less carbide for the process, thus making it less unlikely that it may have a practical application. Neumann assumes that carbon monoxide is formed primarily, while von Knegelgen assumes the primary formation of carbon dioxide. Neumann's paper is to be found in *Zeit. f. Elektrochemie*, October 2; von Knegelgen's paper in the same journal, October 9.

Potential of Amalgams.—REUTER.—An account of an experimental investigation of the electromotive behavior of potassium amalgams. His results correspond with those of Haber and Sark. The results are plotted in the form of a curve which shows a characteristic large jump at the point corresponding to the alloy Hg_{12} K. The potentials have about the position on the curve which they should have according to Berthelot's rule. The potential of pure potassium and pure sodium is lowered considerably by slight additions of mercury.—*Zeit. f. Elektrochemie*, October 16.

REFERENCES.

Dusseldorf Exposition.—DANNEEL.—Continuations of his illustrated serial on electro-chemical exhibits at the Dusseldorf Exposition. Several instruments of Hartmann & Braun and electric laboratory furnaces of Heraeus are described and illustrated, and some data are given on power gas installations.—*Zeit. f Elektrochemie*, October 16, 23.

Electro-chemical Engineering.—As a supplement of the *Centralblatt f. Accum.* there is now being published *"Elektrochemische Technik,"* which is a reportorium arranged in alphabetical form of new articles, papers and patents concerning electro-chemistry, electrometallurgy and electric plating.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Influence Machine.—WOMMELSDORF.—An illustrated description of a new type of influence machine which combines the advantages of former types with the possibility of producing a greatly increased quantity of electricity. The ebonite cylinder holds nine armature discs, separated by ebonite rings. Alternating with these discs are the exciter discs. Each armature disc consists of two equal ebonite discs adhering to each other, and holding between them a number of metallic sectors, which appear through sectors cut in the ebonite. These discs are there for the purpose of collecting the free electricity from the surface of the dielectric and should be made of some thicker material than the ordinary tin foil. The machine produces an internal current of air, which has the double advantage of pumping out the ozone and of producing a slightly lower atmospheric pressure. The location of the armature discs has the effect of doubling their capacity. The machine is said to be specially suited for x-ray apparatus to be used on the battlefield.—*Ann d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 21.

REFERENCES.

Compensator.—EDELMANN.—An illustrated description of a compensator for precise measurements with combined sliding and plug contacts. The sliding contact is used for rough adjustment, while the plug contacts serve for the exact adjustment.—*Elek. Zeit.*, November 10.

Electric Meters.—ZIEGENBERG.—The first part of an illustrated article on electric meters. The author first discusses in general the different types of meters, and then begins to describe some improvements made in recent years in motor meters.—*Zeit. f. Belencht.*, November 10.

Determining the Specific Gravity of Liquids.—An illustrated description of a new "araeo-pyknometer" devised by Raikow, which enables one to determine the specific gravity of the same small quantity of a liquid easily at different temperatures. The instrument is a modified form of hydrometer; the liquid to be measured is placed in it, and the apparatus is then floated in water at the desired temperature.—*Centralblatt f. Accum.*, November 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telephony.—COLLINS.—An illustrated article on his system of wireless telephony. He uses long electric waves, produced by means of low-frequency, high-potential currents. The primary of his sending induction coil is in series with the transmitter, battery, variator and key; the terminals of the transformer are connected to the earth and to a compensating capacity; bridged across the terminals of the secondary is a Leyden jar condenser; the receiver is formed of a closed circuit, which has the telephone, a single dry cell, and the secondary of a transformer, in series; the primary of the transformer is earthed as in the case of the transmitting secondary of the induction coil. He succeeded in transmitting speech over three miles, the articulation being clear and loud enough for commercial purposes. He proposes to equip vessels with his system for communication with the shore.—*Elec. Rev.*, November 29.

REFERENCE.

Wireless Telegraphy.—The first part of a summary of some recent wireless telegraphy patents. The first is a patent of Prof. Fleming and the Marconi Company for an apparatus producing electrical oscillations of very high frequency and also great energy, for the purpose of accomplishing long-distance wireless telegraphy. Another patent of the same inventors relates to an apparatus designed to overcome the danger due to a sudden make or break in the primary circuit of an alternating-current transformer. Another patent to Fleming relates to apparatus designed to obviate the opening and closing of the primary circuit in order to cut up the trains of waves into signals. Another patent of the Marconi Company, which is described, relates to a device to syntonize or tune the transmitting and receiving apparatus to each other, so that signals cannot be received by any other instrument; this method has already been referred to in the Digest. A patent of Blondel's system with monotelephones is then discussed at length.—Lond. *Elec.* November 14, 21.

MISCELLANEOUS.

REFERENCES.

Fused Quartz.—An illustrated description of chemical apparatus which is now made commercially of fused quartz. The price is still rather high. It is said that such apparatus can be heated up

to about 1,400° C., without having their shape changed.—*Zeit. f. Elektrochemie,* November 13.

Electric Kitchen.—Coleman.—An illustrated article describing electric apparatus for the kitchen.—*Elec. Age,* December.

Biographical.—McFarland.—A biographical sketch with portrait of George Westinghouse.—*Cassier's Mag.,* December.

New Book.

National Electric Light Association. Twenty-fifth Convention, Cincinnati, Ohio, May 20, 21, 22, 1902. New York: James Kempster Printing Company. 720 pages, illustrated.

As a contribution to technical literature, the present volume of the *Proceedings* of the National Electric Light Association is by far the most valuable of the series to date. In fact, in this respect it compares favorably with any of the volumes of the *Transactions* of the American Institute of Electrical Engineers, with the advantage that all of the material is of an essentially practical character. The increased value lies largely in the "Question Box" department, which covers 163 pages, and includes consideration of 71 questions and answers relating to matters of practical interest to the central station man. In the entire range of electrical literature we know of no contribution to the operative side of electrical engineering that compares at all with that here given in intrinsic value.

The other contents are with some few exceptions also of live interest and highly practical in character. The most notable contributions are the several papers and discussions on rates, on lamp efficiency from the operative standpoint and on polyphase distribution in cities. Other papers of intrinsic value are on protection of long-distance transmission lines, meters, liquid fuel and 220-volt lamps. Prof. Mathews' annual report of work on arc lamp photometry forms another contribution of the highest value to this subject. The association is to be congratulated that in carrying out its purposes as a body of central station men banded together for business purposes, it should at the same time be a source of such excellent contributions to technical literature.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: December 19th, "Braking and Traction Brakes," J. D. Keiley and R. A. Parke; January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Maximum Demand Indicator.

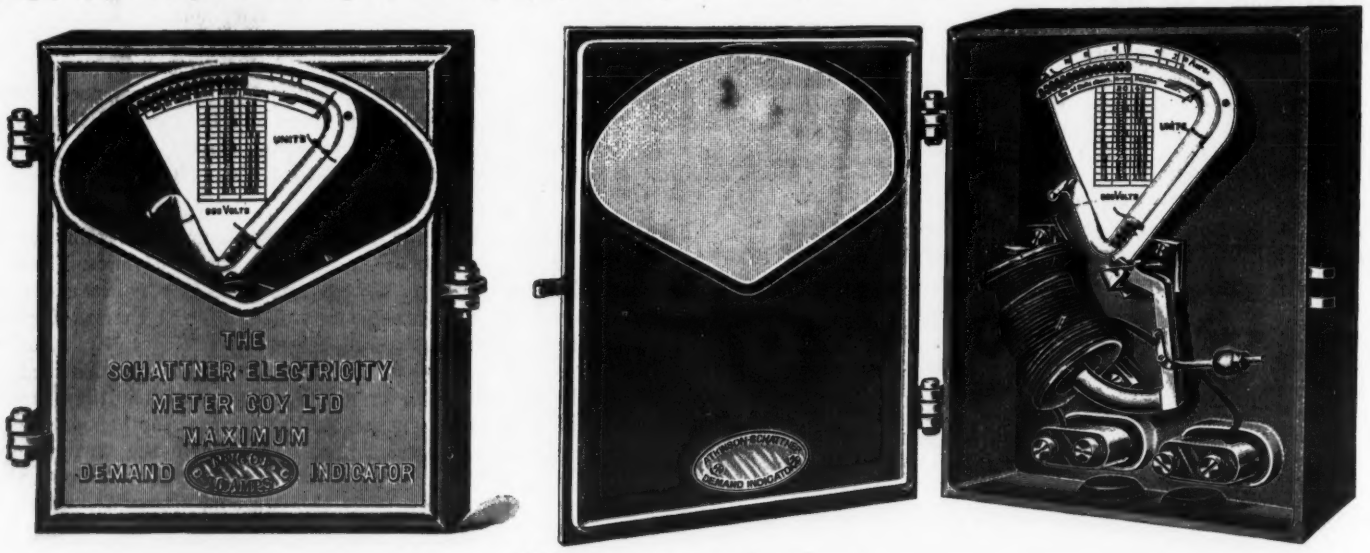
The accompanying illustration shows a new type of maximum demand indicator, which recently has been very largely adopted by English central stations. The inventor is Mr. E. B. Schattner, whose name is well-known in connection with the art of electric meters. The instrument is manufactured by the Schattner Electricity Meter Company, Upper Street, Islington, London.

The instrument is extremely simple in construction, and consists essentially of a metallic frame pivoted at the center, and carrying at one end a cylindrical iron core entering a solenoid, and at the other end a glass tube and scale. As will be seen from the engravings, one part of the glass tube is bent to the arc of a circle concentric with the pivot of the frame. The tube contains a number of steel balls, and is filled with glycerine or oil.

When current is passing the core is sucked into the solenoid, and the frame is tilted to the right of its pivot; any balls to the right of the highest point of the curved portion of the tube then slowly slide down and pass around the bend into the lower limb of the tube, where they remain. If at any time the frame is tilted by the solenoid still further to the right, one or more additional balls will be caused to descend into the tube. Consequently, when the meter is to be read, it is merely necessary to count the balls contained in this tube in order to determine the maximum current that flowed in the period since the meter was last set.

The tube is filled with oil or glycerine, the viscosity of which determines the speed at which a ball passes through the curved portion of the tube. A time element is thus introduced which prevents a ball descending into the lower limb if the higher current is merely momentary. According to the viscosity of the oil chosen, this leeway may vary from less than a minute to ten or more, and the time element can be made still larger by the use of glycerine as the fluid in the tube. Changes in the temperature of the fluid merely act to change this time element, in the selection of which there is considerable latitude. The balls, which are of steel and highly polished, are of the same type as those used in bicycle bearings.

The upper part of the sector carrying the tube is graduated, and in reading the sector is moved so that the end of the line of the balls remaining in the curved tube comes below a point projecting down from the case, when the maximum amperes that had passed in the circuit can be read off on the scale. There may also be printed on the scale a table giving the charging rates.



Maximum Demand Indicator.

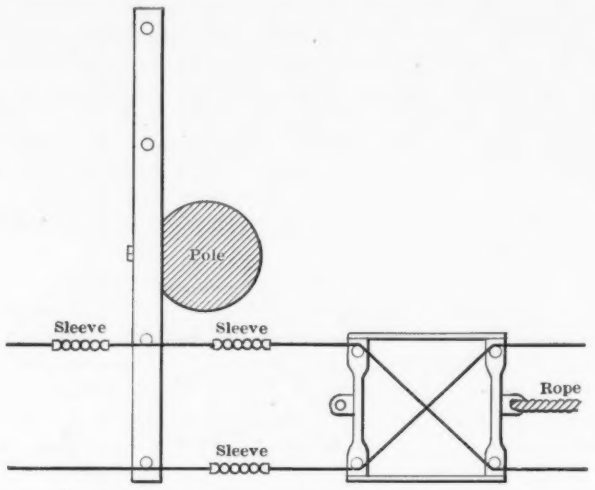
The tube is supported in the sector by three light wire clips; to reset, the tube is removd and tilted until all the balls are returned to the curved portion, when it is reclipped in the frame. The coils of the solenoid are so wound as to give as nearly as possible a uniform pull, and the range of the pull is such that one ball goes down for every quarter of an ampere in the middle of the scale, and for every half ampere on the remainder of the scale. To set the scale to zero, there is an adjustable weight on an arm projecting from the pivoted frame.

Transposition of Line Wires.

The method of transposing telephone and other line wires in general use at present consists in cutting in on the cross-arm or pole. The materials used for such a transposition are two full and six half sleeves, two transposition pins, two pairs of transposition insulators and about six feet of wire. When it becomes necessary to renew cross-arms or poles, the transposition has to be cut out and then replaced, while it often occurs that linemen working on poles step on a transposition, thereby causing a short circuit on the line which is often difficult to locate.

In a patent recently granted to James O'Brien and John Mattmore, of 12 Burgher Avenue, West Brighton, Staten Island, New York, it is claimed that these disadvantages are obviated by a system whereby the transposition is cut in at a pole and then by the aid of a rope is moved to any desired point between the poles.

The material used for a transposition consists merely of three full-



METHOD OF TRANSPOSING LINE WIRES.

connector sleeves and a short piece of wire. There is by this method no interference in renewing cross-arms or poles nor in pulling up slack wires, and danger of short-circuiting the line at the transposition is obviated. The principles of the method are plainly indicated in the accompanying illustration.

Annual Meeting of Electrical Trades' Society.

The seventh annual meeting of the Electrical Trades' Society was held at the Astor House, New York, December 9th. The president's address and the reports of the secretary and treasurer showed the society to be in a very flourishing condition. It was decided that, beginning with next year, the annual meeting will be held in the evening and will be followed by a dinner, thus blending the business and social sides very agreeably. A committee composed of J. H. Dale, J. J. Gorman and R. E. Gallaher was appointed to promote the success of this new procedure. The officers elected for the ensuing year were H. A. Reed, president; J. H. Dale, vice-president; A. P. Eckert, secretary and treasurer; and the following directors: F. V. Bennis, R. E. Gallaher, J. P. Marshall, J. J. Gorman, and H. R. Shwartz.

R. E. Gallaher was appointed delegate to the National Board of Managers, which convenes at Cincinnati in March.

New Hand Microtelephone.

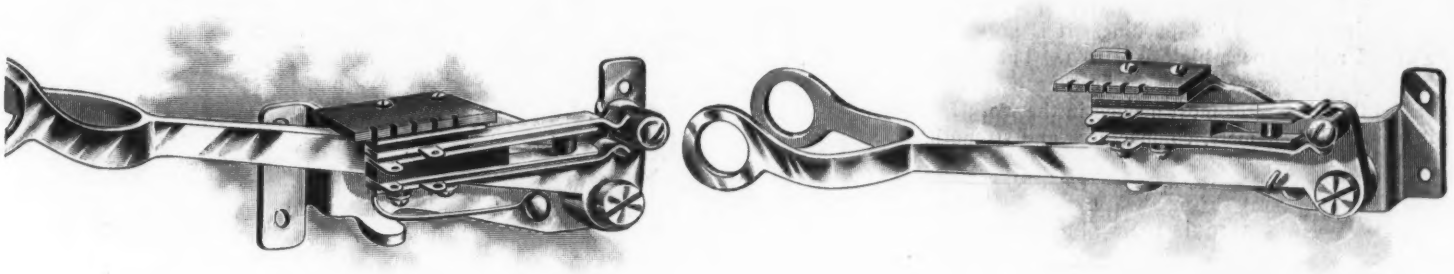
MICROTELEPHONE.

This instrument is intended for use in place of an ordinary desk telephone or where a hand telephone is desired. It is made up in the best possible manner and can be wired for use on any system. It is fitted with hard rubber handle, hard rubber mouthpiece, long-distance transmitter, bipolar watchcase receiver in nickeled bronze shell, silk conductor cord, and terminal block, on which is mounted the induction coil. In the type shown, a presser switch in the handle is arranged to do all the necessary switching, thus doing away with a hook switch, as used in other types of instruments.

A similar form has no switch in the handle, the necessary switching being done by means of a hook switch on which the hand microtelephone is hung when not in use. This apparatus is being put on the market by the Connecticut Telephone & Electric Company, of Meriden, Conn.

A New Telephone Hook-Switch.

In Figs. 1 and 2 are shown two perspective views of a new hook-switch recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The hook is of the long lever type and mounted on a heavy brass frame fastened with bolt and nut. The hook lever forms no part of the circuit, but all contacts are made by the springs mounted upon the lug on the side of the frame, as shown. The downward movement of the hook causes a hard-rubber insulated pin, attached to the lever, to be drawn in between the springs, thus disengaging the springs and breaking contact, as shown in Fig. 2, and making contact when the hook is released, as in Fig. 1. A stop is provided at the lower edge of the frame to prevent the downward movement of the lever, below the proper point. The springs are made of German silver of good length, and all contacts are pure platinum; pure hard-rubber strips are used to insulate the springs from each other and the frame. At the top of the lug, upon which the springs are mounted, is fastened a strip of hard fibre with the front edge slotted, through which the wires are brought down to the springs, thus keeping them separated and reducing the chances of short-circuiting to a minimum.



FIGS. 1 AND 2.—TELEPHONE HOOK-SWITCH.

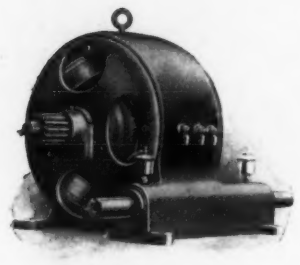
Increase of Traction by Magnetism.

Previous mention has been made in these columns of experiments carried on for several years past by A. A. Honey, of Tacoma, Wash., to increase the traction between car wheels and rails by means of electro-magnetism. Mr. Honey's experiments have been so successful that a company has been formed, with headquarters at Chicago, for equipping electric cars and locomotives with apparatus for increasing traction. On a fifteen-ton, double-truck car at Seattle, Mr. Honey's latest apparatus increases the traction between wheels and rails 350 per cent., with an expenditure of 2½ hp of electrical energy. The importance of this to electric roads in the way of increasing braking power on a slippery rail can hardly be overestimated.

It also has an important application in increasing the traction of locomotives, both steam and electric, because by so increasing the traction of a locomotive, it greatly increases the useful work which the locomotive can perform, because the work done by most locomotives is limited by their traction in starting a train.

The magnetic effects produced are somewhat remarkable. An idler wheel is used on the rail just outside the car wheel for completing the magnetic circuit from car wheel to rail and back to the truck frame or axles. The idler is carried on an arm, one end of which has a bearing on the axle just inside the car wheel. This arm has the magnetizing wire wound upon it. The Magnetic Equipment Company, of Chicago, controls the patents on the apparatus and is about to go ahead with the manufacture of it on a large scale.

A Countershaft Geared Motor.



GEARED MOTOR.

With the increasing tendency toward the direct application of electric motors for machines requiring power in any considerable amount, conditions often require the direct attachment of the motor to a slow-running shaft. In many such cases it is desirable to make the whole speed reduction, or at least a considerable part of it, at the motor itself. The easiest way of accomplishing this is by the use of a motor having the countershaft as a part of the machine. The cut herewith shows a type of motor for this purpose as manufactured by the Crocker-Wheeler Company, of Ampere, N. J.

The motor possesses certain features of the standard semi-inclosed machine, a prominent one of which is the ability to revolve the end plates one-quarter or one-half revolution, retaining the oil wells beneath the shaft in case the motor is semi or completely inverted. The support for the countershaft bearings is part of the motor frame, and being placed near the base of the motor, gives great rigidity to the countershaft. It will be noticed that each end of this support has projecting lugs for holding down bolts, which permit of a very solid attachment for the entire frame of the machine. It is possible to give a speed reduction as high as 8 to 1. The above motor has met with great success wherever used, as it possesses those features most needed in the work for which it is intended, namely, compactness and strength.

Enameled Steel Lamp Shades.

The Federal Electric Company, of Chicago, which manufactures electric signs of enameled steel, has been so impressed with the strength and fine appearance of the white enameled steel ware used in its sign work, that it is now offering lamp shades of the same ware. The enamel is of the highest grade, giving a surface fully equal to porcelain. These shades are especially applicable to electric cars, and places where a porcelain shade is liable to be broken. When used with a car cluster, which involves the removal of the cluster before the shade can be removed, they are especially desirable, because they are practically indestructible, so that there will never be any necessity of taking the cluster apart to renew the broken shade. The shade can be tapped with a standard pipe thread so that it can be screwed directly to the iron pipe of a fixture.

The Butler Drill Chuck.

We illustrate herewith a new drill chuck which has recently been placed on the market by the Butler Chuck Company, Greenfield, Mass. This chuck differs in construction and principle from any heretofore made, and the results obtained from its use are said to be very satisfactory. Its distinctive feature is the enormous grip which is obtained upon the drill or other tool it is holding.

Fig. 1 shows the chuck in two sections, with the working parts exposed. It consists of an arbor sleeve, cap, plug and three jaws. The arbor and sleeve appear at the left, the cap, plug and jaws at the right in Fig. 1. The arbor or shank can be turned to any taper desired. The end of the arbor, or that portion which enters the knurled sleeve, has on its surface a right-hand thread. The center of the arbor is bored and tapped to receive the left-hand threaded plug corresponding to the thread on the surface. Around the arbor revolves the knurled sleeve to which is rigidly attached the conical cap. The sleeve and cap

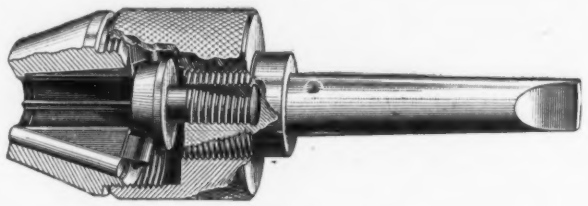


FIG. 1.—DRILL CHUCK.

work together, except when assembling or dismantling the chuck. Within the conical cap are three oblique converging channels which guide and support the jaws. Above the cap, in Fig. 1, is shown the left-hand threaded plug, on the lower face of which are three horizontal converging channels, in exact relation to those in the cap and into which are placed the upper flanges of the jaws.

The jaws are wedge shape forgings, on the back and top of which are circular flanges to correspond with the channels in the cap and plug. When the chuck is assembled, the plug is screwed into the arbor and the sleeve screwed firmly to the cap. Thus by revolving the body of the chuck to the right, it travels up the arbor at the same time the plug travels down into the

FIG. 2.—DRILL CHUCK.

cap, forcing the jaws out with just half the revolutions usually required, also confining the travel of the body to a very short distance. The friction rests on the plug, which is of small diameter, and the grip of the hand in tightening the chuck is greatly multiplied through the differential screw. By the aid of this same feature the resistance of the work continually tends to tighten the grip. The chuck is made of steel throughout, such parts being hardened as are subject to severe wear.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was decidedly firmer, with small offerings, closing at 6 per cent. for all dates, with a commission in addition in some cases. The stock market was dull and heavy in tone, owing to the renewed high rates for both call and time loans. Little interest was taken in the market by the public. The traction stocks receded after showing strength on exaggerated reports about the scope of the Manhattan deal. The latter sold off in spite of the declaration of a dividend which puts the stock on a 6 per cent. basis, and the action of the directors in reference to a forthcoming issue of rights to the present stockholders. The industrials were dull and generally heavy, although United Steel stocks held fairly well. Amalgamated Copper was sold by Boston houses on statements that there is a renewed accumulation of the metal in the hands of producers. In Brooklyn Rapid Transit 208,645 shares were sold at prices ranging from 64 to 67¾, closing at 64¼, a net gain of ⅜ point. Met. St. Ry. closed at 139¼, a net loss of ⅝, after having reached 145¼, the closing figure being but ¼ point above the lowest of the week. Manhattan lost 8¾ points net, closing at 147¼, one-quarter point above the lowest figure, the highest being 157⅛. General Electric was dull, closing at 176½, a net loss of 2½ points. Westinghouse, both issues, was inactive, closing at 200 for the common and 206 for pfd., being net losses of 6 and 2 points respectively. Western Union dropped ¾ point net, closing at 87¾. Following are the closing quotations of December 9.

NEW YORK.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Tel. & Cable..	89	88	General Electric	177	178
American Tel. & Tel...	159	160	Hudson River Tel.....	—	—
American Dist. Tel.....	35	34	Metropolitan St. Ry....	141½	139¾
Brooklyn Rapid Transit.	64⅝	64⅜	N. E. Elec. Veh. Trns..	⅛	—
Commercial Cable	170	—	N. Y. & N. J. Tel.....	162	163
Electric Boat	20	22	N. Y. E. V. T. Co....	—	10
Electric Boat pfd.....	37	37	Tel. & Tel Co. Am....	—	—
Electric Lead Reduc'n..	3½	3⅜	Western Union Tel.....	87¾	87¾
Electric Vehicle	4	3½	Westinghouse Com.....	200	195
Electric Vehicle pfd....	11	10	Westinghouse pfd.....	205	200

BOSTON.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Tel. & Tel..	160¾	160⅛	Western Tel. & Tel. pfd	—	98½
Cumberland Telephone .	—	126	Mexican Telephone	2	2
Edison Elec. Illum....	—	—	New Eng. Telephone...	137	137
General Electric	178½	—	Westinghouse	101	—
Western Tel. & Tel....	—	25	Westinghouse pfd	102	—

PHILADELPHIA.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Railways.....	52¾	—	Phila. Traction	97¾	97¾
Elec. Storage Battery...	79	79	Phila. Electric	8¾	8½
Elec. Storage Bat'y pfd	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9½	9½	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
Central Union Tel.....	—	—	National Carbon pfd....	100*	97
Chicago Edison	175	—	Northwest Elev. Com..	—	—
Chicago City Ry.....	211	208¾	Union Traction	14¼	13½
Chicago Tel. Co.....	—	—	Union Traction pfd	45	45
National Carbon	30*	26			

* Asked.

DIVIDENDS.—The directors of the General Electric Company have declared a regular quarterly dividend of $2 per share upon the common stock, payable Jan. 15. Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent., payable Jan. 2. The directors of the Commercial Cable Company have declared the regular quarterly dividend of 1¾ per cent. and an extra dividend of 1 per cent., payable Jan. 2. The directors of the Manhattan Railway Company met last week and increased the dividend on the stock from 4 to 6 per cent. by the declaration of a quarterly dividend of 1½ per cent., as compared with payments of 1 per cent. each quarter since 1896. From 1891 to that time 6 per cent. per annum had been paid. The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1 per cent. on the capital stock, payable Jan. 3.

GENERAL ELECTRIC.—Previous to the declaration of the regular dividend of $2 per share on General Electric a few days ago there were rumors, says the *Wall Street Journal*, that an increase in the rate might be looked for. It is now rumored, notwithstanding that no such action was then taken, that the stock is not unlikely to be put on a 10 per cent. basis three months hence. Insiders discourage all such expectations. Among people in touch with the company's affairs it is said that while business is fully up to the limit of the company's capacity, and while profits are satisfactory, the latter are not quite as large as they might be, nor as large as it was estimated they would be, at the time when taken. Large increases in wages is a main reason assigned.

STOCK EXCHANGE TELEPHONES.—When the New York stock exchange moves into its new building, members will be taxed for the privilege of having a private telephone booth on the floors of the exchange. This is an innovation, as heretofore there was no tax, except $50 a year for the telephone boys' card. Hereafter, however, the members will have to pay a tax ranging from $350 to $100 a year according to the place of the booth. Members have received a notice from the governing committee requesting them to make application for booths, giving a diagram of the booths, and the price for the various situations.

INDIANA LIGHT AND TROLLEYS.—The Indiana Company, capital $1,000,000, with $500,000 paid in, filed papers of incorporation last week in New Jersey to construct railways and electric light plants in Indiana. The incorporators are Thomas Dolan, Randall Morgan, Franklin H. MacMorris, Clinton N. Latourette and George H. Martin. Most of these incorporators are Philadelphians.

ILLINOIS ELECTRIC VEHICLE.—The liquidation committee of the Illinois Electric Vehicle Transportation Company, at Chicago, has arranged to wind up the affairs of the company by the payment of $1.50 per share to the stockholders. The par value of the shares was $5 each. About $260,000 was recovered from the total investment.

CHICAGO EDISON STOCK.—To meet cost of general improvements, the Edison Company will issue $2,276,901 new stock at once to shareholders at par. This will leave $133,429 in the treasury. Payments will be made in four installments on Feb. 2, May 1. Aug. 1, and Nov. 1. This raises the total capital of the company to $9,866,000.

DETROIT EXTENSIONS.—Directors of the Windsor, Sandwich & Amherstburg Electric Railway, controlled by the Detroit United Railways Company, have authorized a $600,000 mortgage to secure an issue of 5 per cent. bonds to be applied to the completion of the system from Sandwich to Amherstburg.

PARIS GAS AND ELECTRIC.—A corporation intended to absorb all the gas and electric companies of Paris is being formed, it is stated, by A. N. Brady and W. C. Whitney. The capital of the corporation will be $50,000,000, with the stock about equally divided between American and French capitalists.

NEW YORK & QUEENS ELECTRIC.—Application has been made to the New York Stock Exchange to list New York & Queens Electric Light & Power Company $342,000 additional first cons. mortgage bonds of 1930.

HUDSON RIVER POWER.—A Saratoga dispatch announces that the Hudson River Power Company will, on Dec. 23, consider a proposition to increase its capital stock from $2,000,000 to $5,000,000.

SIEMENS & HALSKE COMPANY, of Germany, has taken up for the whole of Europe the Pupin "loaded" telephone cable patents owned here by the American Bell telephone interests.

Commercial Intelligence.

THE WEEK IN TRADE.—The advent of seasonable winter weather has stimulated trade in winter goods, and retail trade in general has assumed its usual seasonable aspect. Cold weather from now out is needed to insure the large movement of corn expected, as the result of active export and home demand. *Bradstreet's* summarizes the trade conditions as follows: "The year's approaching end finds prices well up to the highest point in eighteen months, though meats, an important element in food supplies, are steadily declining on good receipts. November bank clearings showed small gains over the same month last year, no doubt being curtailed by mild weather limiting crop movement and retail trade, but the 1902 total (eleven months) is now only half of 1 per cent. below 1901, with prospects that the deficiency will be more than made up in December. Business failures are smaller than a year ago in number and much smaller in liabilities, and the year to date shows the smallest number for ten years past. The efforts of the railroads to break the freight blockade have been partially successful, and the situation, here, at least, is mitigated, though not entirely relieved, with the result that fuel supplies are larger and industry surer of being uninterrupted than for some time past. Railway gross earnings thus far reported for November are heavily in excess, at least 10 per cent., of the same month a year ago. Next to the expectations, already partly realized, that an enormous holiday business will be done, the most notable feature is the practical unanimity of opin-

ion that a large spring trade is in prospect, ground for this being furnished by the unprecedented volume of such business already booked. The feature in foreign trade is the turn in the tide of corn exports, which have at last begun to expand after fifteen months of scarcity, high prices and trifling shipments." Iron trade conditions are quieter, in keeping with seasonable changes. Foundry iron is slightly lower for next month's delivery. Increased furnace capacity would seem to guarantee more liberal supplies of iron next spring, and there would really seem no real chance for foreign iron, imports of which for October were smaller than for September, while exports were larger, a significant indication of the foreshadowed change in foreign trade currents. Steel rails are still actively in demand. Hardware is still quite active, a feature being liberal ordering for next spring's delivery. Among the other metals, tin and copper are stronger. Prices of copper here advanced as a result of the advance on the London market. Quotations are normal, Lake being 11.50c.; electrolytic and casting stock 11⅜c.; Standard 11.50c. The exports of the metal for November aggregated 10,520 tons, which is the smallest for any month this year, so far. The business failures for the week ended December 4, as reported by *Bradstreet's*, numbered 185, as against 182 the previous week and 237 the same week last year.

THE STANDARD UNDERGROUND CABLE COMPANY has about completed the erection of the largest and most modern plant in this country for rolling copper rods, drawing all sizes and shapes of bare wire and insulating weatherproof wires and cables. This plant is an addition to its large underground cable factory and rubber insulated wire and cable factory at Perth Amboy, N. J. The rod mill was started successfully on November 25 and the wire mill will be in full operation immediately. The company is prepared to furnish bare rods and wire in any quantities, the capacity of the rod mill being 3,000,000 lbs. per month and the wire mill 2,000,000 lbs. single turn. The weatherproof factory will be in full operation by Feb. 1, 1903, with a capacity of 500,000 lbs. of wire and cables per month working single turn. The sales department staff has been largely added to on account of this new departure and the general increase of business. The general sales department, with headquarters in Pittsburg, together with the branch office managers at New York, Philadelphia and Chicago, remain the same. Mr. A. B. Saurman, who has represented the company in Boston for the past few years, goes to San Francisco, where he is associated with Mr. C. F. Sloane, the Pacific Coast sales agent of the company; Mr. Saurman devoting his attention exclusively to the interest of the company on the coast. The Boston office is now in charge of Mr. Frank Clarke Cosby, formerly the representative in St. Louis. The New York office force is augmented by the presence of Mr. H. P. Kimball, formerly with the Williamsport Electric Company. Mr. R. M. Hirst, for several years connected with the Philadelphia office, will devote most of his time to the trade in that territory. The Pittsburg office will have two men constantly on the road; Mr. A. A. Anderson, who has been with that office for several years, and Mr. McBride, formerly with the Pittsburg Reduction Company. Mr. J. R. Wiley at the Chicago office will be assisted by Mr. E. J. Pietzcker, formerly with the American Steel & Wire Company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has included among its shipments of engine type generators for the month of November, one 400-kw for the Stephen Girard Building, Philadelphia, Pa.; one 100-kw; one 125-kw for the Missouri Pacific pany, McKees Rocks, Pa.; one 200-kw for the Penna. Malleable Company, McKees Rocks, Pa.; one 200-kw for J. L. Mitchell, Philadelphia, Pa.; two 50-kw for the Liveright & Greenwald Building, Philadelphia, Pa.; two 100-kw for the McClintic-Marshall Construction Company, Pottstown, Pa.; one 300-kw for the Grand Crossing Tack Company, Chicago, Ill.; one 400-kw for the Lake Construction Company, Erie Co., Pa.; one 250-kw for the Wilmington City Electric Company, Wilmington, Del.; one 225-kw for the Pine Bluff & Western Railway, Pine Bluff, Ark.; two 150-kw; one 200-kw; one 75-kw for the Woodward & Lothrop Building, Washington, D. C. The company reports that its new mill building is now being occupied, enlarging its floor space by 60,000 sq. ft., giving increased facilities for prompt deliveries on large orders.

PRICE OF COPPER.—The well known copper trade expert, H. L. Casey, says: "On December 1st there was 135,000 tons, or 300,000,000 lbs., of copper in this country, which is the largest amount ever carried at this date. Before January 15th, copper will sell below 11 cents per lb., and next year it will sell as low as 10 cents. I am positive that a big sale of copper is pending, and that a block of 60,000,000 lbs. will change hands within the next month. During the year 1903 we are going to witness a sharp cut in the prices of nearly all finished materials. Finished steel is selling much too high, and prices cannot be maintained many months. Only a few years ago steel rails were selling at $14 per ton. They are now $28, but they must go back to $14 or $18."

BALL ENGINE ORDERS.—Mr. W. M. Buchanan, Odell, Ill., has recently purchased a 150-hp direct-connected engine from the Ball Engine Company, Erie, Pa. C. C. Hengle, Jr., & Bros. Co., of Louisville, Ky., have recently purchased a direct-connected unit for electric purposes. The Ball Engine Company furnishes the engine and the Bullock Electric Manufacturing Company the generator. The Magnus Metal Company, of Chicago, is installing an electric power plant consisting of 150-hp vertical engine and 60-hp horizontal. The engines, which are direct-connected to Milwaukee Electric Company generators, were furnished by the Ball Engine Company. The Ball Company has recently installed a 125-hp engine in the electric plant of the City of Farmville, Va. The Lord & Burnham Company, Irvington, N. Y., has recently installed a 100-hp engine, purchased from the Ball Engine Company.

TELEPHONY AT BLOOMINGTON, ILL.—The independent telephone exchange at Bloomington, Illinois, which was established nearly seven years ago, is being greatly enlarged by the Equitable Construction Company, of Chicago. A large amount of cable is being placed underground as well as aerial and the exchange is being re-equipped with International lamp signal central energy multiple switchboard and long-distance central energy telephones. The exchange is being built with a capacity for 2,400 subscribers, and it is said, when completed, it will be one of the best constructed and most modernly equipped exchanges in the independent telephone field. The apparatus will be built by the International Telephone Mfg. Co., of Chicago.

MESSRS. ROSSITER, MACGOVERN & CO., New York, have purchased the entire equipment of the 25th Street power house of the Metropolitan Street Railway Company, New York, comprising 4,000 kw in generators. Three years ago this apparatus, which consists of 850 kw units, was considered the finest obtainable, but the rapid march of improvement has rendered it unavailable for present purposes. Most of this equipment has been sold to the Massachusetts Electric Companies and will be installed at the power house at Lowell, Mass. It will be recalled that Messrs. Rossiter, MacGovern & Co. bought the 146th Street station equipment of the Metropolitan Company last year.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Oakland Transit Consolidated, located at Oakland, California, for the installation of a battery of chloride accumulators to be used on its railway system. The battery consists of 264 cells having a capacity of 550 kw, and in connection with a booster is to be installed at the center of distribution of the system, about two and one-half miles from the generating station. It is to be used to reduce the amount of feeders otherwise necessary and to regulate the fluctuations of load on the generators at the power house.

CONTRACTS PENDING FOR MEXICAN LIGHTING PLANTS.—The City of Tampico, Mexico, is to have a new electric light plant. A company has been formed in Tampico for the purpose of building and operating the works. The capital of the undertaking is $200,000. It will be more than a year, however, before the new plant is in active operation. In the meantime the present owners of the existing plant are perfecting plans for a considerable increase in capacity. The equipment will be purchased almost immediately in the United States.

THE K. & B. COMPANY is the name of a new company, established at 56 N. 7th Street, Philadelphia, for the purpose of manufacturing yellow pine cross arms, locust insulator pins, electrical moulding and ceiling blocks and dealing in switchboards, panelboards, motors and generators, railway equipments and special electrical supplies. The members of the company are Mr. Richard L. Binder, formerly manager of the engineering department of Vallee Bros. Electrical Company, and Mr. W. H. G. Kirkpatrick.

SUPPLY OF COPPER.—The *Wall Street Journal* says: "The production of copper by the Greene Consolidated Copper Company is now at the rate of 60,000,000 pounds a year. This is according to official statements. It comes to us from excellent authority that the General Electric Company now owns a sufficient amount of Greene Consolidated so that from now on the Greene will supply the company with all the copper it needs."

TELEPHONE SERVICE FOR MEXICO CITY.—M. G. Ribson, general manager of the Mexican Gas and Electric Light Company of the City of Mexico, has submitted to the municipal authorities a proposition for the construction of an extensive telephone service.

TELEGRAPH CONTRACT.—As the first result, presumably, of George J. Gould's election to the directorate of the Kansas City, Mexico and Orient Railroad, the Western Union Telegraph Company has made a contract with the Orient Railroad to conduct its telegraph business for twenty-five years.

YOUNGSTOWN, O., PLANT TO BE ENLARGED.—The Youngstown-Sharon Railway & Light Company, of 46 Wall Street, is about to considerably enlarge its Youngstown, O., plant. The existing equipment is capable of developing 2,400 hp. The boilers are of Babcock & Wilcox build, fitted with Roney mechanical stokers. The pumps were furnished by the Blake branch of the International Steam Pump Company. The engines comprise Harrisburg & Green-Wheelock cross compound types and Williams vertical machines. These engines are direct coupled to Westinghouse alternating current, 2,200 volt, two-phase, 60-cycle generators. The initial plant was installed by Sanderson & Porter, of 31 Nassau Street, New York, which engineering concern is acting as consulting experts in the matter of the new extension also. Contracts have already been placed for two 400-hp Babcock & Wilcox boilers; a 1,000-kw, 100 r.p.m. alternating current generator of Westinghouse manufacture, to be direct-connected to a Green-Wheelock horizontal cross-compound engine of 28-in. x 50-in. x 48-in. dimensions. A 12-in. x 7½-in. x 12-in. Blake feed pump has been ordered. A 75-kw Westinghouse exciter unit for direct coupling to a Westinghouse compound engine will also be installed. The Cleveland Crane & Car Works, of Cleveland, O., will furnish a 15-ton crane for its engine room. Orders have also been closed for a constant current transformer for a street lighting system of 450 lamps, 7½ ampere, and six 100 special lights. This portion of the plant will be furnished by the General Electric Company. A new engine room building, 60-foot square, is to be erected. Contracts have yet to be awarded for a 10-ft. x 180-ft. self-supporting steel stack, with steel boiler flue, and for a water softening plant of 4,000-hp capacity. With the new additions, the plant will have a capacity of about 3,000 kw. Two thousand kw will be transmitted to Sharon, 17 miles distant, for the purpose of lighting that city. The remainder of the power will be utilized for operating the electric railway running between Youngstown and Sharon, and also for working the Sharon and Newcastle road. The length of the electric lines is about 33 miles.

LARGE GAS ENGINE AND ELECTRIC EQUIPMENT.—The Atlantic Refining Company's works at Philadelphia, controlled by the Standard Oil Company, are to be converted from steam to gas engine and electrical equipment. The plant will have a capacity of 1,440 kw. There will be four gas engines of 550-hp capacity each, and two of 50 hp each. Two of the larger engines will be built by the Westinghouse Machine Company, of Pittsburg. The other four are to be manufactured by the Alberger Company, of Buffalo. The 550-hp machines will each be direct connected to 360-kw generators, to be built by the General Electric Company. There will be two exciters of General Electric make to be direct connected to the smaller gas engines. The General Electric Company has also been awarded a contract for some 75 three-phase alternating-current motors, varying from 5 hp to 150 hp, to be utilized for operating pumps and other machinery. The Deane branch of the International Steam Pump Company, 114 Liberty Street, New York, has been allotted a contract for 20 pumps, triplex vertical. William E. Quimby, Inc., has taken a contract for ten screw pumps. A 2,800-gallon pump will be direct connected to a 150-hp motor, and will be used for the bulk loading of oil tank steamers. The other Quimby pumps are to be chain driven. The switchboard, which will have four sets of bus bars so as to permit of separate or parallel operation of the generators will be furnished by the General Incandescent Arc Light Company. The contracts for the wiring and the transmission machinery have not yet been decided upon. The plant, which is expected to be completed early next summer, will be the largest gas engine equipment operating alternating generators in parallel hitherto contracted for. Mr. John S. Griggs, Jr., of the electrical engineering firm of Chas. Henry Davis & Partners, is acting as consulting engineer for the Standard Oil people in the matter.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material and machinery from the port of New York for the week ended December 5: Antwerp—36 pkgs. material, $1,841. Amsterdam—1 pkg. machinery, $187; 4 pkgs. material, $101. British Poss. in Africa—155 pkgs. material, $23,005. Brazil—137 pkgs. material, $5,763; 129 pkgs. machinery, $16,749. British West Indies—59 pkgs. material, $1,114. British Australia—148 pkgs. machinery, $17,910; 122 pkgs. material, $6,113. Cuba—26 pkgs. material, $940. Chili—5 pkgs. material, $61. China—34 pkgs. material, $878. Central America—4 pkgs. material, $26. Egypt—3 pkgs. machinery, $118. Ecuador—14 pkgs. material, $95. Genoa—7 pkgs. material, $90. Havre—2 pkgs. material, $685. Hanover—2 pkgs. material, $177. Halifax—1 pkg. material, $21. Hayti—3 pkgs. material, $110. Ipswich—4 pkgs. machinery, $594. London—64 pkgs. machinery, $6,735; 71 pkgs. material, $4,334. Liverpool—69 pkgs. machinery, $2,106; 34 pkgs. material, $2,490. Mexico—2 pkgs. machinery, $42; 68 pkgs. material, $5,255. New Zealand—1 pkg. material, $5. New Castle—1 pkg. material, $52. Peru—11 pkgs. material, $415; 37 pkgs. machinery, $6,816. Rotterdam—2 pkgs. material, $50. Stockholm—4 pkgs. material, $1,721; 3 pkgs. machinery, $862. Southampton—152 pkgs. material, $1,582. U. S. Colombia—55 pkgs. material, $961.

SOME HARRISBURG ENGINE ORDERS.—MacKenzie & Quarrier, of 203 Broadway, New York, the recently formed concern which handles the business in the East for the Harrisburg Foundry & Machine Works, have taken one order for two 250-hp standard engines, each for direct connection to General Electric generators of 160-kw capacity, to be installed in the new plant of the Barber Asphalt Paving Company at Warner, N. J. The machinery will be utilized for lighting and motor load. The Scranton, Pa., Electric Construction Company has requisitioned for a 50-hp standard simple engine for direct coupling to a 35-kw generator of General Electric manufacture. This outfit is intended for lighting purposes. Another order just to hand calls for two 100-hp standard tandem compound engines belted to alternating generators of 60-kw capacity each, to be furnished by the Stanley Electric Manufacturing Company. This equipment is to be installed in an electric lighting plant at Huntington, L. I.

EQUIPMENT FOR EXTENSION OF PORTSMOUTH, N. H., PLANT.—The electrical engineering and contracting firm of Sanderson & Porter, Bank of Commerce Building, Nassau Street, New York, has just let contracts for an extension of the Rockingham County Light & Power Company's plant at Portsmouth, N. H. The additional equipment will consist of one 2,000-kw 13,200-volt, three-phase, 25-cycle generator of General Electric build to be direct connected to a Westinghouse 36 in.x76 in.x54 in. 83 rpm vertical engine. This machinery is intended to furnish power for an extension of the operations of the New Hampshire Traction Company which anticipates the installation of additional sub-station equipment and transmission lines. The New Hampshire Company will give out the contracts for the sub-station machinery direct from its Boston offices, 60 State Street.

POWER AT MEDINA, N. Y.—A new power development and transmission project is being promoted for the vicinity of Medina, N. Y., by A. L. Sweet, of that village. The project is extensive, and will be one of the largest of its kind in the locality. A gorge runs through Medina, and there are several dams in its course. These are owned by companies controlled by Mr. Sweet, and he will remove all but the Medina Falls dam. About a mile below this point he will erect a still larger dam, 540 feet long and 52 feet high. This will create a reservoir of large proportions, from which water will be taken to supply wheels in a power house to be built. The natural conditions are said to greatly aid the project. The trees and brush on the reservoir site are being removed, and a service building is being put up on the power house site.

CAMBRIDGE, MASS., ELECTRIC LIGHT COMPANY has decided to displace the direct-current power distribution system at present installed, by an alternating-current system. This action is being taken after a long and exhaustive investigation into the comparative merits of the various types of direct and alternating current motor apparatus now upon the market, made by the electrician of the company, Mr. W. R. Eaton. The company has recently purchased from the Westinghouse Electric & Manufacturing Company 99 induction motors, which will take care of the bulk of the power service, comprising every possible use of electric power in a city of this kind, from public works to small tailoring establishments. The order comprises 11 motors of 1 hp; 26 motors of 2 hp; 9 motors of 3 hp; 19 motors of 5 hp; 25 motors of 7½ hp, and 9 motors of 15 hp.

TELPHERAGE COAL PLANT.—The Nashua, N. H., Light, Heat & Power Company has put in a telpher system from the United Telpherage Company, of New York City, to handle coal from the spur track in the gas company's shed to the boiler rooms of the electric lighting plant. It is the first telpherage system in the State and reduces greatly the cost of handling the coal. About 75 tons a day will be regularly transported. The buckets are of 500 pounds capacity. If pushed to its full capacity the line could take care of 15 tons an hour.

CONCORD, N. H., HYDRAULIC PLANT.—The Concord Electric Company, of Concord, N. H., whose plant at Sewall's Falls, on the Merrimac River has just undergone extensive repairs by Sanderson & Porter, 31 Nassau Street, New York, is considering the question of a large increase in the capacity of its power house. It is proposed to install a 3,000-hp additional equipment.

LIGHTING SYSTEM FOR NEWBURGH, N. Y.—The Newburgh (N. Y.) Light, Heat & Power Company's plant is to be equipped with a street lighting system consisting of 300 lights capacity, 6 6/10 amperes alternating lamps with constant current transformer and accessory equipment. The contract was secured by the General Electric Company.

General News.

THE TELEPHONE.

WAYCROSS, GA.—The Southern Bell Telephone Company is building long-distance lines into this city.

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company has purchased the telephone line formerly owned by the War Eagle Consolidated Mining Company and which runs from Boise to Twin Springs on the Boise river.

CHICAGO, ILL.—The Chicago Telephone Company made a net gain in subscribers for November of 2,221.

CHILLICOTHE, ILL.—The capital stock of the People's Telephone Company, of this place, has been increased from $10,000 to $20,000.

EDWARDSVILLE, ILL.—The Kinloch Telephone Company, which has conducted only a toll station in this city during the past year, is arranging to open an exchange. Workmen are engaged in stringing wires and placing telephones in a number of business houses.

NEW CASTLE, IND.—The Central Union Telephone Company will expend $7,000 for additional cable and improvements in this city.

FRANKFORT, IND.—The city council has granted a franchise to D. A. Coulter and Eli Marvin to construct and operate a telephone plant.

CRAWFORDSVILLE, IND.—The Crawfordsville Co-operative Telephone Company has been incorporated by Charles R. Beck, George W. Bowers, Charles V. Hodkins, Clarence Williams and William Sinnett.

MUNCIE, IND.—The Delaware and Madison County Telephone Company's system is in operation. The company has 1,400 subscribers to begin with and the local and independent system will in a short time connect with the long distance.

LAFAYETTE, IND.—The telephone system of this city is undergoing important changes which will result not only in an improved service, but wide extensions of the lines and in better facilities of every kind. The cost of the improvement is estimated at $350,000.

EVANSVILLE, IND.—The Municipal Telephone Company has secured subscriptions amounting to about $100,000 and a contract will be closed at once for the construction of the plant. It is stated that as soon as the municipal plant is in operation, a large number of Bell telephones will be discarded.

INDIANAPOLIS, IND.—The Arlington Telephone Company, of Arlington, Rush County, has filed articles of incorporation, with a capital stock of $4,000. The directors are J. M. Cross, Charles Sampson, J. P. Downey, J. S. Smith, Elihu Price, J. E. Munden, J. M. Eaton, William Jordan and Robert H. Moore. The company will construct and operate a telephone plant at Arlington.

EVANSVILLE, IND.—Owing to the fact that the ordinance giving the Cumberland Telephone Company 90 days in which to remove its poles and wires and quit the city was not published until a month after its passage by the council, the company will have until December 17 in which to close up. Nearly $70,000 worth of stock in the Municipal Telephone Company, of Evansville has been subscribed. Mayor Covert says one week more will raise the required amount and the construction company that is expected to do the work of constructing the municipal plant will take what stock remains unsold. Work, he says, will begin soon. During the week the Cumberland Company submitted a proposition to the mayor, that matters of rates to telephone patrons and of compensation to the city for the franchise be left to referees, one to be appointed by the Cumberland Company, one by the city, and these two to select a third, their report to be accepted by both parties. The mayor ignored the proposition for the reason that it leaves all other competing companies out. The mayor says the Cumberland Company seems unable to comprehend that it had lost the Evansville field; that its franchise had been revoked; that its poles and wires were allowed to stand by sufferance only to serve the people until Evansville can arrange for a new telephone service. The Cumberland Company stands with the same and equal footing with other petitioners for the franchise and by no manipulation can it retain its present advantage after December 17. Evansville is in a position to offer the exclusive telephone service of the city to the company presenting the best terms, but there must be but one system and that the best.

BOWLING GREEN, KY.—The Southern Electrical-Construction Company is to build an independent underground telephone system here.

LEXINGTON, KY.—The Independent Long Distance Telephone & Telegraph Company has filed a mortgage to the National Trust Company, of Louisville, to secure an issue of $1,000,000 5 per cent. first mortgage gold bonds. The property mortgaged includes the plant at Louisville with lines through sixteen counties in Kentucky and three counties in Indiana, with all branches and equipment.

OWOSSO, MICH.—The Union Telephone Company is building a line from Flint to Holly.

SAGINAW, MICH.—The Valley Telephone Company has made a contract with the Alma Telephone Company for the construction of a line from Flint to Holly connecting with the Alma company. A connection will also be made with the Oakland Telephone Company, giving Oakland county connection with the northern part of the State.

DETROIT, MICH.—The merger ordinance permitting the consolidation of the two projected independent telephone companies, has passed its third reading in the council. The time for the raising of the money for the purchase of the two companies—the People's and the Co-operative—should the special committee to which the franchise is granted decide to buy—was extended from 60 days to six months.

NORTH BRANCH, MINN.—The Maple Leaf Telephone Company has incorporated with a capital stock of $50,000.

BILLINGS, MONT.—The Rocky Mountain Bell Telephone Company has opened its office at Red Lodge, thus giving a second line of communication between that city and Billings.

OMAHA, NEB.—The Vail Telephone Company has been incorporated with $10,000 capital by J. M. Glynn, H. Stuck and others.

NEW YORK, N. Y.—The John Street exchange of the New York Telephone Company was burned out in some inexplicable manner last week, and has been put in service again by dint of very hard work. It will be some time, however, before the effects of the damage can be entirely wiped out.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has purchased a site here on which the company will erect a three-story building to be used as an exchange.

ELMORE, OHIO.—The Ottawa County Telephone Company has increased its capital stock from $30,000 to $36,000. Improvements are being made.

XENIA, OHIO.—The United States Telephone Company is building a line into Xenia, touching Yellow Springs. It will furnish long distance connections for the new exchanges at these points.

CLEVELAND, OHIO.—It is generally believed that the Federal Telephone Company will pay the July coupons on its bonds about the middle of December and there is every indication that the January interest will be paid on time.

WELLINGTON, OHIO.—A rate war has broken out between the Wellington Home Telephone Company and the Central Union Telephone Company. The home company has 350 telephones, while the Bell Company has only 150, but the latter is making rapid gains.

HAMILTON, OHIO.—The Hamilton Home Telephone Company expects to commence furnishing service about January 1. A Kellogg switchboard, with an ultimate capacity of 3,000 lines, has been installed. The company will give long-distance service over the lines of the United States Telephone Company.

NEWARK, OHIO.—Material has been ordered for an exchange at Pataskia, and this will be built as soon as the Utica exchange, now under construction, is completed. Both exchanges will be operated in connection with the Newark Home Telephone Company. The Newark Company is expending about $50,000 in improvements and extensions.

OTTAWA, OHIO.—The secretary of the Columbia Telephone Manufacturing Company of this place has filed a report with the district court, giving the assets of the company as $40,197 and the liabilities as $38,172. Several creditors have brought suits for settlements. Local people plan to reorganize the company and continue the business.

CANTON, OHIO.—Directors of the Stark County Telephone Company, one of the leading properties of the Federal Telephone Company, have decided to spend $100,000 in improvements. The system at Alliance will be improved and about 1,000 additional lines will be strung in Canton. Much new cable work will be installed and the rural lines and village exchanges will be improved.

SALEM, OHIO.—The Columbiana County Telephone Company will spend $100,000 in improvements during the next few months. From 800 to 1,000 new subscribers will be taken care of at once and the various exchanges in the county will be enlarged. The company will make a connection with the Beaver Township Telephone Company, giving that service.

ROSEWOOD, OHIO.—The Champaign Telephone Company has elected the following named officers: M. E. Weimer, president; C. H. Espy, vice-president and treasurer, and T. H. Heck, secretary and manager. The above, with W. H. Fledderjohn, Peter Weimer and N. L. Stremble are directors.. The company has purchased the toll lines from St. Paris to Springhill and will install automatic exchanges at Springhill and Millerstown. Construction work is to start at once.

CLEVELAND, OHIO.—As soon as possible after the new city government goes into effect, the Cuyahoga Telephone Company will apply for a change in its franchise to permit it to increase its rates. The maximum price will probably be fixed in the new ordinance on a basis of 10,000 telephones with the right to make additional charge for each 1,000 new lines installed. The demand for telephones has increased very rapidly during the past year and at present the company is operating over 10,000 lines. This number could easily be increased by a considerable figure. President Dickson, of the company, is quoted as saying that the company originally planned for 5,000, and with that number of subscribers could make good money at the present rates of $36 and $48, but with double that number, at the present time, the company admits that it is impossible to make anything.

COLUMBIA, S. C.—The South Carolina Telephone Company has just completed rebuilding the line between Camden and Sumpter, S. C.

OGDEN, UTAH.—The city council has granted a franchise to the Utah Home Telephone Company. The directors of the new company are Gov. Heber M. Wells, J. H. Smith, Geo. T. Odell and Elmer B. Jones.

LEHI, UTAH.—Lehi City has granted to Reed Smoot, Jesse Knight, C. E. Loose, George Havercamp and S. R. Thurman the right of way franchise for the construction and operation of a system of telephone and street railway upon the streets of Lehi.

EASTVILLE, VA.—The Diamond State Telephone Company has bought the Peninsular Telephone Company and the Onancock Company and will have control of the whole telephone business on the Eastern shore of Virginia and Maryland. It will make improvements in the service here.

TIGARDVILLE, WASH.—The Tigardville Telephone Company, capital $1,000, has been incorporated by John Gaarde, C. F. Tigard and E. J. Goodman.

BELMONT, W. VA.—A telephone system to connect at this point with the Belmont system is to be built from Centerville.

PARKERSBURG, W. VA.—The West Virginia Western Telephone Company will build lines to Elizabeth and Gransville. Much new work is being done in Parkersburg.

ELKMOUND, WIS.—The Elkmound Telephone Company has incorporated with a capital stock of $5,000. The incorporators are C. A. Silkworth, W. A. Mau and J. E. McCoy.

LARAMIE, WYO.—Telephone wires have recently been strung to Holmes, Centennial, Pollock and many important ranches in Centennial Valley. A new line will be built at once from Garrett's to Sybille and another to Tie Siding.

ELECTRIC LIGHT AND POWER.

GRIFFIN, GA.—An election will soon be held on the question of a $100,000 bond issue for sewerage, improvement of water and lighting systems, etc.

SAVANNAH, GA.—The Savannah Electric Company proposes to expend $40,000 extending its road at West End. Geo. J. Baldwin, the president, has asked for a franchise.

LEWISTON, IDAHO.—The city council has closed a contract with the Westinghouse Electric & Mfg. Company for a 200-hp motor at a cost of $3,300 for the new water works plant. A contract was also closed with C. C. Moore & Co., for a Deane pump of 2,500,000 gallons capacity at a cost of $3,627.

EDWARDSVILLE, ILL.—At the annual meeting of the Edwardsville Electric Light and Power Company three old directors—C. H. Fisher, G. H. Watterau and Henry Wiebusch, all of St. Louis—were re-elected and two new members—Ole Petersen, of St. Louis, and A. A. Tebbe, of Washington, Mo. The latter two replaced Frederick Gut and C. A. Vallette.

MARTINSVILLE, IND.—The city council has repealed its action granting a franchise to E. O. Tompkins, of Indianapolis, for an electric lighting system.

BLUFFTON, IND.—A company of local citizens and representing $25,000 capital has been organized to erect an electric lighting plant. The city is to pay a rental of $2,500 a year.

KOKOMO, IND.—George F. McCulloch, president of the Union Traction Company, and H. N. Stillwell, president of the Indianapolis Northern Traction Company, have applied for a franchise for an electric lighting plant at this place.

FARIBAULT, MINN.—The machinery at the State Farm is driven by electric power transmitted at a pressure of 2,200 volts. Mr. A. R. Tracy, the electrical engineer, has just raised the voltage of the line from 1,100 to 2,200 volts. The farm machinery is operated by a 12-hp single-phase motor, which has put the old steam engine out of business.

ST. LOUIS, MO.—The electrical subway for the cables to supply the electric current for the Louisiana Purchase Exposition has been completed. The contract was let in two sections. One section has wooden shelves at the sides to carry the cables, and a passageway through the center for the linemen engaged in repairs. This subway is 8x8 feet in cross section and is 4,200 feet long. The Barwick Construction Company built it, completing it early in the summer. The second section was completed last week. This section passes under the lagoons and had to be built water-tight. There are 540 feet of this. The entire cost was $25,985.

RALEIGH, N. C.—The Raleigh Ice and Electric Company will operate its ice-making machinery by electricity, power to be derived from the new $80,000 power plant at Milburnie on the Neuse river.

ALBANY, N. Y.—The Otsego Light, Heat and Power Company, of Oneonta, has been incorporated, capital $100,000. Directors: Edward C. White and Herbert T. Jennings, Mount Vernon, Charles V. D. Peek, New York.

FREMONT, OHIO.—The Fremont Electric Light Company has sold out to the Logan Natural Gas Company.

ELYRIA, OHIO.—The Citizens' Gas & Electric Light Company, Elyria, Ohio, is adding to its electrical equipment, etc.

NORTH AMHERST, OHIO.—The village authorities are taking steps to establish the municipal lighting plant authorized at a recent election.

CINCINNATI, OHIO.—The village of Home City is debating the question of installing a municipal lighting plant. The plan is generally favored.

IVORYDALE, OHIO.—Proctor & Gamble, soap makers, contemplate the erection of a large central power station. The company has just purchased additional land adjoining its plant and it is believed it will be used for the purpose mentioned.

ELYRIA, OHIO.—The Citizens' Gas & Electric Company is enlarging its steam capacity and is preparing to install three 250-hp. Babcock & Wilcox boilers. They will be fitted to burn natural gas. The company will make a number of other improvements to its system.

TOLEDO, OHIO.—The Central Heating & Lighting Company has proposed an ordinance to secure a franchise for lighting and heating. The company offers to put up a bond for $20,000 to bid for the city lighting at $68 per light and to pay to the city two per cent. of its gross receipts after January, 1908.

AKRON, OHIO.—A property owner has applied for a franchise to enjoin the Northern Ohio Traction Company from furnishing light to the city under the contract recently made by the council. It is claimed the city commissioners did not advertise for proposals for lighting the city, thereby depriving property owners of the benefits of competitive bidding.

CINCINNATI, OHIO.—The city will shut down the electric lighting plant at Linwood which was acquired several years ago when the village became part of the city, and which has since been operated by the water works department. The Cincinnati Gas & Electric Company has extended its service to that part of the city, and the old plant will be dismantled.

CONNEAUT, OHIO.—The Pittsburg & Conneaut Dock Company is preparing to erect a power plant with a view to operating all the ore-unloading machinery and the haulage system used in moving freight cars, by independent m. .s supplied from the station. Work of installing the plant is to start at once. Pittsburg contractors will put up the plan.

MILLERSBURG, OHIO.—The Millersburg Electric Light Company controlled by Mt. Vernon people, has sold out to a Cleveland syndicate headed by O. P. and M. J. Van Sweringen, who will take possession December 15. The new company will improve the plant and will install a hot water heating system for the purpose of supplying business men and citizens with heat.

CLEVELAND, OHIO.—Prominent business men in the down-town section of the city have taken under advisement a plan proposed by Professor C. H. Benjamin, the former smoke inspector, for the establishment of a central lighting and heating station in the heart of the city. It is proposed to operate the plant on the co-operative plan. It is pointed out that several of the largest buildings are already heated from a single plant.

ERIE, PA.—The Edison Electric Light & Power Company has been awarded the contract for street lighting for five years, the price being sixteen cents per lamp per night for enclosed arcs.

THE ELECTRIC RAILWAY.

DENVER, COLO.—Mayor R. R. Wright, Jr., and eleven aldermen have been sentenced by Judge John I. Mullins, of the District Court, to serve four months in jail for contempt of court in disregarding the injunction issued by Judge Mullins to restrain the enactment of an ordinance granting a franchise to the Denver City Tramway Company. The ordinance which was passed over Judge Mullins's injunction grants the Denver City Tramway Company a franchise to run for twenty years, and permits the collection of a five-cent fare on all the street car lines of the city for that period. Efforts were made by a minority of the board of aldermen to correct these features of the bill, but the majority refused to permit any changes to be made.

NEW ALBANY, IND.—The New Albany, Paoli & French Lick Traction Company has been granted a franchise to operate over the streets of this city.

INDIANAPOLIS, IND.—The Consolidated Traction Company, of Indianapolis, has been incorporated with a capital of $300,000 to build a system northwest of the city.

INDIANAPOLIS, IND.—The Indianapolis & Northwestern Traction Company has been incorporated with a capitalization of $3,000,000. This company is a reorganization of the Indianapolis, Lebanon & Frankfort Traction Company and will construct a line to Lafayette. Tucker, Anthony & Co., of Boston, are the financial backers of the enterprise.

NEW CASTLE, IND.—The New Castle & Muncie Traction Company has been incorporated to construct and operate street railways in the cities and towns of New Castle, Mt. Summit, Springport, Oakville, Cowan, Muncie, Alexandria, Hartford City, Portland, Bluffton, Marion, Ft. Wayne, Cambridge City, Keystone, Dunreith and Connersville and to connect and operate interurban lines between said cities and also supply them with electric light, power and steam heat. E. T. Ice, F. W. Nixon, C. B. While and C. C. Hunt are the promoters. The home office will be in New Castle.

COVINGTON, KY.—The Union Light, Heat & Power Company has brought suit against the city to enjoin it from issuing $75,000 of bonds for the erection of a municipal lighting plant. The case is an appeal from a lower court. A resolution has been adopted by the city council to repeal the franchise of the company for alleged failure to supply certain lights.

SYRACUSE, N. Y.—It is announced that the Syracuse Rapid Transit Company will build a line to Oswego at a cost of $1,000,000.

GREENSBORO, N. C.—The city has granted a franchise to the company projecting a trolley line to connect High Point, Greensboro and Winston. F. E. Darlington and Geo. Cohen, of Philadelphia, and others are interested.

DELAWARE, OHIO.—A project is on foot for the construction of an electric railway from Springfield to Delaware by way of Mechanicsburg, Milford, Catawba and Marysville.

HUDSON, OHIO.—The Hudson Improvement Company, recently organized by business men, has arranged with Youngstown parties to install an electric lighting plant, franchise for which has been secured.

CLEVELAND, OHIO.—Now that its affairs are assuming normal condition, the Everett-Moore syndicate is planning to again push the project of the Illinois Central Traction Company. J. B. Hanna, former secretary of the Cleveland City Railway Company and one of the members of the Everett-Moore syndicate, is president and general manager of the company which had secured a number of valuable franchises and rights of way in Illinois, shortly prior to the Everett-Moore embarrassment.

WILKESBARRE, PA.—A New York syndicate is making arrangements to take control of the Wilkesbarre and Wyoming Valley Traction Company, which operates several lines from this city. The same syndicate has also assumed control of the Reading, Pa., and Wilmington, Del., traction companies. President Rigg, of the local company, is the head of them all.

COLUMBIA, S. C.—The Lexington and Columbia Railway Company has applied for a franchise here. The company proposes to connect Columbia and Lexington by trolley.

LEGAL.

MARCONI-DEFOREST.—The DeForest Wireless Telegraph Company filed its answer last week in the United States Circuit Court to the suit of the Marconi Wireless Telegraph Company for infringements of patents. The attorneys for the De Forest Company are Fish, Richardson, Herrick & Neave and Edmund Wetmore. They set up that Marconi's devices for wireless telegraphy were anticipated by Edison, A. E. Dolbear and other inventors.

MUNICIPAL PLANTS ARE TRUSTS.—The Indiana Supreme Court has just decided that municipal plants are trusts and that the common council of a city cannot sell or transfer property held by it for public uses or governmental purposes without special authority of the Legislature. Such property is held in trust for the inhabitants. Electric light systems and water works plants are within the class of property held for public use or governmental purposes, and therefore not subjects of sale to private corporations or individuals.

TELEPHONE TRANSMITTERS.—The Kellogg Switchboard & Supply Company has brought suit against the American Electric Telephone Company, of Chicago, for infringement of patent No. 687,499, dated November 26th, 1901, granted to William W. Dean for a telephone transmitter and also on patent No. 704,697, dated July 15th, 1902, granted to William W. Dean for a switch-hook. It has also brought suit on the same transmitter patent against the International Telephone Manufacturing Company, of Chicago. These patents cover the Kellogg standard apparatus, and are alleged to be infringed.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL WIRELESS TELEGRAPHY COMPANY, of New York, has been incorporated with a capital stock of $10,000. The directors are Isaac Neberger and A. W. Rose, of New York, and M. J. Kenny, of Summit, N. J.

THE MISSOURI ELECTRICAL CONSTRUCTION COMPANY, for the construction and equipment of all apparatus or machinery operated by electricity, has filed letters of incorporation at St. Louis. The capital stock is $2,000. The incorporators are Samuel G. Payne, Barton J. Parker and Hickman J. Rodgers.

PERSONAL.

JAMES M. DODGE.

MR. JAMES M. DODGE, who was last week elected president of the American Society of Mechanical Engineers, was born June 30th, 1852, at Waverly, N. J. His grandfather was Prof. James J. Mapes, the celebrated scientist, and his mother Mary Mapes Dodge, a well-known author for many years editor of the St. Nicholas Magazine. Mr. Dodge entered Cornell with the class of '71 and completed his junior year at that institution. He then went to Rutgers College and took a special course in chemistry for a year. He served his apprenticeship with John Roach, the famous ship builder, in New York and at Chester. He then became connected with the Ewart Manufacturing Company, of Chicago, builders of link-belt machinery. Since that time Mr. Dodge has been very prominent in that branch of manufacturing. He is now president of the Link-Belt Machinery Co., of Nicetown, Philadelphia, of the Dodge Coal Storage Co., and of the Dodge Stair-Lift Co. He is one of the managers of the Franklin Institute, of Philadelphia, and a director in several manufacturing establishments. He has taken out over one hundred patents, principally on conveying machinery. Mr. Dodge has not been himself particularly active in the electrical field, but he is an enthusiastic convert to motor driving and his shops at Nicetown contain a model installation of electrically driven tools, while he takes a keen and most intelligent interest in electrical development. His son, Mr. Kern Dodge, is a member of the American Institute of Electrical Engineers and is already widely known for his work in connection with electrical power transmission for tools and factories generally.

MR. WILLIAM FAHNESTOCK, the well-known Wall Street financial leader, has become a director in the Metropolitan Street Railway Company of New York.

PROF. DR. F. HABER, of the Technische Hochschule, Karlsruhe, Germany, is still in this country studying electrochemical developments and is now making a trip down South.

MR. WILLIAM STARK SMITH, of the Browning Manufacturing Company, Milwaukee, Wis., paid New York a visit the early part of this week on his way East in behalf of his company.

MR. R. S. MASON has been appointed consulting electrical engineer of the Los Angeles Railway Company to prepare or pass upon all plans of electrical machinery and apparatus, and to outline the arrangement of installation.

MR. EDWARD DURANT, electrical engineer for the city, at Ward's Island, New York, has resigned and has accepted a position as electrical engineer for the big Gould steam yacht *Niagara,* sailing this week for a long winter cruise in the Mediterranean.

MR. E. B. SCHATTNER, inventor of the Schattner demand meter, returned this week to London after a stay of three or four weeks, during which time, in spite of ill health, he managed to see a good deal of electrical station and factory work in different parts of the country.

MR. C. E. L. BROWN, the distinguished electrical engineer of Switzerland, and in many ways the European leader in power transmission work, is the subject of the Bullock Company's calendar card for December. The card gives a good little portrait in colors and a brief but excellent biographical sketch.

MR. L. S. KIRKER, formerly electrical engineer of the Wheeling Steel & Iron Company, Wheeling, W. Va., has bought the plant of the Center Foundry Company. He and his friends have also purchased the Pittsburgh Engine & Foundry Company and will manufacture gas engines under the Kirker patents.

MR. C. H. MACKAY, president, and George G. Ward, vice-president of the Commercial Cable Company, W. H. Baker and E. C. Bradley, vice-presidents of the Postal Telegraph Company, started last week for San Francisco to see the beginning of the laying of the new Pacific cable to connect this country with the Hawaiian and Philippine Islands.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has sailed for England, accompanied by Mrs. Insull, so as to arrive in time for the Christmas holidays which will be spent with friends. Mr. Insull has recently been doing some very hard work in connection with the various electric lighting properties under his management and ownership.

TOWNSEND-MULFORD.—At Plainfield, N. J., on Dec. 3, Miss Margaret May Mulford, daughter of Mrs. Margaret A. Mulford, and William Raymond Townsend, both of that city, were married at the home of the bride's mother in East Fifth Street. The Rev. Dr. W. C. Snodgrass, pastor of the First Methodist Episcopal Church, officiated. The bridegroom is in the auditing department of the Metropolitan Street Railway Company, of New York.

MR. H. P. WHITNEY.—It is announced that Harry Payne Whitney has retired from racing and has sold out his interest in race horses to his partner, Herman Duryea. Mr. Whitney's withdrawal from the turf was occasioned by the earnest wish of his father, W. C. Whitney, that the son should more seriously devote himself to affairs of business in connection with the various electrical and other interests with which their names are associated.

SIR HIRAM MAXIM is, according to a dispatch from London, soon coming to the United States, where he intends to remain for about two years in the hope of finding a cure for a troublesome throat complaint, which is the result of an attack of bronchitis and laryngitis six months ago. He will also prosecute experiments with the view to building a flying machine. The experiments will, the dispatch states, be conducted in Connecticut or on Long Island.

MR. O. W. BRAIN, electrical engineer of the Sydney City and Suburban Tramways, Sydney, Australia, is now on a visit to the United States. He has come here for the purpose of inquiring into the best American traction and lighting methods and securing data regarding equipment, etc., for submission to the New South Wales Railway Commissioners who operate the Sydney system with a view to their letting contracts, shortly after receipt, for considerable extensions. An article in these pages last week described the plant.

MR. CHARLES T. YERKES, who is building an underground road in the English capital, was one of the passengers on the Deutschland in port this week. He will be in this country until after the holidays, attending to his American interests, and will then return to London, where he is building some 50 miles of tube railway. One branch, the Baker Street and Waterloo, will be finished in about eighteen months. This branch is seven miles long, and is a double "tube." The Metropolitan system will be equipped with electricity in about fourteen months.

MR. L. W. MILLER, treasurer of the Goudey-McLean Company, of 88 Maiden Lane, New York, export sales managers for a number of American manufacturers of electrical machinery, supplies, etc., who has been in Europe inspecting the various branches of the company for some months past, will reach London shortly from the Continent and will make his headquarters at the company's agency in the British metropolis—the Associated American Electrical Manufacturers, Limited, 47 Victoria Street, Westminster, S. W., for the next three or four months.

MAJOR A. C. LOTBINIERE, deputy chief engineer of the Mysore Government, India, who has been on a short visit to this side, sailed for Europe Saturday last on the Cunarder *Campania.* He carries with him considerable data regarding further American equipment, which, subject to the approval of the Mysore authorities, will mean the placing of further important contracts in this country in connection with the increasing from 4,000 hp to 10,000 hp of the Cauvery Falls transmission plant, the initial electrical equipment of which was furnished by the General Electric Company.

HON. CHARLES ALGERNON PARSONS, F. R. S., to whom the British Royal Society has just awarded its Rumford medal "for the successful application of his invention of the steam turbine to industrial purposes, and in navigation," is a brother of the Earl of Rosse and a son of the builder of the famous Birr telescope. When Mr. Parsons built the *Turbinia,* in 1896, she was the first vessel to be propelled by the steam turbine. At the present time there is only one turbine-engined war-vessel in the world. This is the British destroyer *Velox,* and she has the distinction of being also the fastest vessel in the world.

MR. GEORGE W. RISTINE, of Chicago, has been appointed to the management of the St. Louis Exposition's Transportation Department on the recommendation of the Committee on Transportation. He will take charge of all transportation business within the province of the committee, including "all business pertaining to the transportation of property or persons in connection with the preparation for, and the holding of the Exposition." The Department of Transportation is distinct from the Department of Transportation Exhibits, which has been organized with Willard A. Smith as chief. Mr. Ristine will have charge of matters relating to rates, operation of tracks, and all business with transportation companies outside of exhibits.

MR. E. C. PLATT, the well-known treasurer of the Postal Telegraph Cable Company, has sustained a sad and sudden loss in the death of his daughter, Miss Edith Hunter Platt, aged only 19, of heart failure. She had suffered from heart trouble for some time, and the indirect cause of her death was probably the excitement accompanying her introduction into society, which took place on Friday evening last week at a coming-out party given in her parents' home, in Brooklyn. Miss Helen Lynne, a friend of Miss Platt, remained in the house over night. On Saturday morning she went into her friend's room and found her groaning and apparently suffering great pain. A doctor was summoned, but Miss Platt was dead before he arrived.

MR. GEORGE W. MASCORD, chief mechanical engineer of Edward Lloyds, Limited, of London, the publishers of "Lloyds Weekly" and the "Daily Chronicle," sailed for Europe Saturday last on the *Campania*. Mr. Mascord had been on this side for about four months seeking ideas for the erection and equipment of an electrically operated newspaper printing plant to be built in the British metropolis by his principals. It will be the largest plant of its description in Europe. Before completion, it is to cost nearly $750,000. Mr. Mascord has taken estimates over with him to Europe as regards the electrical machinery. Immediately after his arrival on the other side the matter will be brought up by his directors and the contracts determined on.

Trade Notes.

THE FT. WAYNE ELECTRIC COMPANY, Fort Wayne, Ind., will spend $65,000 in adding another story to its factory.

THE ACME ELECTRICAL APPLIANCE COMPANY, of St. Louis, has increased its capital stock from $5,000 to $10,000, all the increase being paid.

MAGNETO-GENERATOR.—Some important parts about the new Stromberg-Carlson magneto-generator are given in a neat folder (bulletin No. 2) recently issued by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.

DOWN-DRAFT FORGES.—The Buffalo Forge Company, Buffalo, N. Y., describes and illustrates a very complete line of down-draft stationary and heating forges for industrial works. These forges are of the most modern design, and the variety represented is rather striking. The features and dimensions of each style are briefly given.

THE ELECTRICAL MATERIAL COMPANY, of Baltimore, Md., has issued a catalogue of "All Things Electrical." This is a comprehensive title, but the contents of the catalogue, which has nearly 250 pages, indicate that it is well chosen, since every department of electrical application is represented. The catalogue is copiously illustrated, price-lists of each article being given.

INDUSTRIAL RAILWAY CARS.—The Atlas Car & Mfg. Company, Cleveland, Ohio, manufactures a complete line of cars and other equipment for industrial works. In two catalogues of recent issue the company illustrates its products very effectively. It does not confine itself to standard sizes, but builds cars of any style and size to suit the requirements of its customers.

GENERATOR CALLS.—It is reported that the International Telephone Manufacturing Company, Chicago, is having a large demand for its new generator-call telephones, especially for country party line and long distance toll line use. It is said that this instrument embodies in the construction of the parts, many new features that are of vital importance to the durability and efficiency of a telephone plant.

THE ELECTRIC APPLIANCE CO., Chicago, selling agent for Guttmann alternating current wattmeters, announces that although it is shipping hundreds of these meters every week, it is still, owing to the increased facilities at the factory, able to keep up with its orders and make prompt deliveries. It desires to give wide publicity to this, as the rapid growth of its meter business during the past three years has not always found it in this enviable position.

CASE ENGINES.—The New Britain Machine Company, New Britain, Conn., in an artistically gotten-up pamphlet describes very fully the features and advantages of the Case automatic high-speed engine. The subject is well illustrated by handsome wood-cuts, half-tones and line drawings of complete engines of various styles and parts. Several of the illustrations show engines driving electric generators, centrifugal pumps, ventilating fans, etc.

HARRISBURG ENGINES.—President W. R. Fleming, of the Harrisburg Foundry and Machine Works, has issued the following: "It is our pleasure to announce that the interests of this company centering in and about its New York office, 203 Broadway, and at present under the capable management of Mr. W. P. Mackenzie, having prospered and expanded beyond expectation, will be conducted, on and after November the first, by the firm of Mackenzie and Quarrier, to whom we with pleasure extend our continued confidence and patronage."

MARCONI FICTION.—The story tellers follow hard on the heels of the inventors. An extremely clever bit of fiction à la Marconi is "Mr. Potter's Vacation," by Herbert D. Ward, in the December *McClure's*. It is the history of a great battle in stocks fought from the deck of an ocean liner. One thousand miles of ether were kept hot for two days with long range orders to buy and sell. Mr. Potter won, of course, but the author was probably guilty of irony in speaking of the trip as a vacation. *Harper's Weekly* for Christmas has also a good Atlantic Marconi story.

ELEVATING AND CONVEYING MACHINERY.—The trade literature of the Jeffrey Mfg. Co., Columbus, Ohio, is always interesting, on account of its completeness. The company's products are so varied that to completely catalogue them requires a good-sized volume. The latest catalogue issued by this company contains no less than 372 pages, exclusive of the four-page index at the back. Everything manufactured by the company in the line of power transmission machinery and labor-saving appliances is illustrated, and on many pages are shown views of actual operative installations. The size of the catalogue is 5¼x7¾ inches.

USE AND CARE OF STORAGE BATTERIES.—The Columbus Storage Battery Company, Columbus, Ohio, has just issued a 32-page pamphlet containing a short treatise on the use and care of storage batteries, together with a catalogue of small storage cells manufactured by this company. A description of the construction of the Columbus storage battery elements is well illustrated. Other illustrations show the methods of connecting storage batteries for different purposes. The pamphlet is deserving of a place in electrical libraries on account of the complete and general information it contains on the subject of care and use of storage batteries.

THE LIVING AGE as it enters upon its sixtieth year and 236th quarterly volume still maintains the high standard of literary excellence which has characterized it from the beginning. It presents in an inexpensive form, considering its great amount of matter, with freshness, owing to its weekly issue, and with satisfactory completeness the best essays, reviews, criticisms, serial and short stories, sketches of travel and discovery, poetry, scientific, biographical historical and political information, from the vast field of foreign periodical literature. The following list includes some of the writers represented in a single year's numbers of the Living Age: Algernon Charles Swinburne, Sir Gilbert Parker, A. T. Quiller-Couch, The Bishop of Ripon, Augustine Birrell, Mrs. Alice Meynell, W. B. Yeats, Andrew Lang, Katharine Tynan, Maxwell Gray, Sidney Lee, Herbert Paul, Sir Edwin Arnold, Edmund Gosse, George Meredith, Fiona Macleod, Maurice Mæterlinck, Hilaire Belloc, Sir Wemyss Reid, John Buchan, Sir Rowland Blennerhassett, Eugene Melchior de Vogue, Leslie Stephen, Lord Rosebery, Paul Bourget, W. L. Courtney, Professor Edward Dowden, Henry Lawson, Arthur Christopher Benson, Max Beerbohm, Jane H. Findlater, Owen Seaman, W. E. Heneley, The Hon. H. H. Asquith, Pierre de Coubertin, William Watson, W. S. Lilly, Maxime Gorky, G. M. Trevelyan, Sir Lewis Morris, John Morley, Emily Lawless, Theophile Gautier, Prince Kropotkin. This review of contemporaneous literature is issued at $6 a year, or 15 cents for single copies, by the Living Age Co., of Bromfield Street, Boston.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 2, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

714,680. PAY-TELEPHONE; C. E. Egan, Durham, N. C. App. filed April 22, 1902. (See page 963.)

714,681. SIGNAL-BELL FOR TELEPHONE SYSTEMS; C. E. Egan, Durham, N. C. App. filed Sept. 17, 1902. (See page 963.)

714,695. ELECTROMAGNETIC TRACTION INCREASING DEVICE; A. A. Honey, Tacoma, Wash. App. filed April 1, 1902. A bar of iron pivoted on the axle at one end and carrying a truck at the other, is surrounded by a magnet coil which can be thrown into circuit at will, to increase the traction by bringing the truck into engagement with the rail and establishing magnetic attraction between the two and between the car wheel and the track.

714,716. COMBINED CURB AND CONDUIT; F. Lappin, Washington, D. C. App. filed May 12, 1902. The curb is hollow and provided with internal supports for the conductors and with a cover.

714,718. OVERHEAD CONDUIT FOR ELECTRICAL SERVICE WIRES; F. C. Locke, Boston, Mass. App. filed May 31, 1902. Hooks strung upon a span wire receive a number of service conductors.

714,721. ARMATURE WINDING FOR ELECTRIC MOTORS OR DYNAMOS; R. Lundell, New York, N. Y. App. filed Jan. 23, 1902. The coils are laid upon the surface of a drum armature in two or more layers, the adjacent inner and outer coils of the different layers being connected in sequence to consecutive commutator bars.

714,734. ELECTRIC BLOCK SIGNAL; E. M. North, Brooklyn, N. Y. App. filed March 22, 1902. A switch lever and semaphore combined, are moved mechanically by the pressure of the car wheel on a push rod.

714,746. ELECTRIC RAILWAY SYSTEM; W. Robinson, Boston, Mass. App. filed Jan. 15, 1898. Electro-magnetic devices for automatically energizing the sections of the working conductor and cutting them out after the car passes.

714,756. METHOD OF SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Boston, Mass. App. filed Feb. 8, 1900. (See Current News and Notes.)

714,760. ELECTRIC ANNUNCIATOR DROP; E. G. Thomas, Cambridge, Mass. App. filed March 29, 1900. Details.

714,769. CARBON HOLDER FOR DYNAMO ELECTRIC MACHINES; C. Zabel, B. Zabel and W. Zabel, Edgewood Park, Pa. App. filed Oct. 28, 1901. Details of construction.

714,775. ELECTRICAL PROCESS OF LOCATING RUNNING WATER IN THE EARTH; F. H. Brown, Los Angeles, Cal. App. filed March 31, 1902. The vibrations caused by running subterranean streams are transformed into electrical pulsations which are detected by telephone.

714,786. CONTROLLING ELECTRIC MOTORS; M. W. Day, Schenectady, N. Y. App. filed Sept. 26, 1900. (See Current News and Notes.)

714,810. THERMOSTAT; T. Vesconte, Minneapolis, Minn. App. filed Feb. 11, 1901. A bulb with a liquid-containing department has a diaphragm, the movement of which makes it break an electric circuit. The liquid contained may be sulphuric ether.

714,811. BRUSH HOLDER; D. Litchfield, Schenectady, N. Y. App. filed April 30, 1901. Instead of the current passing through the entire brush spring, it is shunted by a conductor to a point of the spring near where the latter bears on the carbon brush.

714,824. PROCESS OF STARTING INDUCTION MOTORS; A. Schwartz, Cologne, Germany. App. filed March 18, 1901. Consists in pushing the armature out of the field when the latter is cut into circuit, giving a slight rotation to the armature, then bringing the armature back into the field.

714,831. APPARATUS OF SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

714,832. APPARATUS FOR AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1902. (See Current News and Notes.)

714,833. METHOD OF AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

714,834. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Cambridge, Mass. App. filed Oct. 4, 1902. (See Current News and Notes.)

714,851. RAILWAY AND CAR AND MAGNETIC APPLIANCES THEREFOR; A. C. Alertson, New York, N. Y. App. filed April 8, 1902. Magnets carried on the car have their poles presented to an iron rail so placed that the attractive force tends to lift the car from the track, and decrease the running friction.

714,861. PROCESS OF ELECTROLYTIC SEPARATION OF COPPER AND NICKEL; D. H. Browne, Cleveland, Ohio. App. filed Jan. 27, 1899. Copper-nickel powder or fragments are placed in a "tower" and subjected simultaneously to a stream of salt water from the top and a stream of free chlorine from the side. The resulting cuprous and nickel chlorides run into another receptacle containing a nickel-copper anode and by electrolysis the copper is plated on the cathode and the chlorine combines with the copper and nickel of the anode, forming cuprous chloride and additional nickel chloride, which latter after being freed from traces of iron and copper is heated and introduced into a nickel-plating apparatus, where the nickel is deposited and the chlorine drawn off to supply the "tower."

714,862. CONTROLLING ELECTRIC MOTORS; H. W. BUCK, Niagara Falls, N. Y. App. filed Nov. 17, 1900. (See Current News and Notes.)

714,869. CONNECTOR; G. W. Cravens, Schenectady, N. Y. App. filed May 1, 1901. Two cup-shaped devices made separable and carrying corresponding contact parts.

714,881. CLAMPING FINGER; W. L. R. Emmet, Schenectady, N. Y. App. filed May 7, 1902. A gutter-shaped finger intended to be placed against the outer plate of the laminations of an armature to stiffen it.

714,891. TRANSFORMER AND MEANS FOR WINDING SAME; E. R. Gill, New York, N. Y. App. filed May 4, 1899. An arrangement of a divisible spool and a divisible gear for winding the core after it is assembled.

714,893. ELECTRIC CURRENT REGULATOR; J. W. Hammond, Fredonia, N. Y. App. filed July 23, 1902. Details.

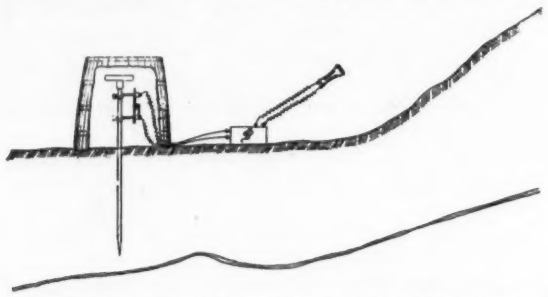
714,904. ELECTROMAGNETIC DEVICE; J. S. Hodges, Troy, N. Y. App. filed April 4, 1902. An arrangement whereby the attraction of a magnet is maintained during the time of reversal of the current.

714,905. ELECTROMECHANICAL CLOCK; S. H. Hoggson, New York, N. Y. App. filed Nov. 27, 1901. Details.

714,927. RHEOSTAT; F. Mackintosh, Schenectady, N. Y. App. filed May 21, 1901. Resistance grids coated with insulating heat-refractory enamel are clamped together with heat-radiating plates between them.

714,928. PLUG AND RECEPTACLE; N. Marshall, Newton, Mass. App. filed Nov. 7, 1900. A face plate having a hinged door carries plug-sockets supported immediately behind the door with which connection is made by plugs after first swinging the door open.

714,934. MEANS FOR PREVENTING BREAKDOWN OR HIGH POTENTIAL WINDINGS; W. S. Moody, Schenectady, N. Y. App. filed



714,775.—Electrical Process of Locating Running Water in the Earth.

April 26, 1902. The admission of high potential current to a winding, is resisted by the inductance of the winding, so that there is an appreciable interval before the inner portions of the winding are raised in potential in accordance with its terminal points. To prevent breaking down of the insulation at such times between a terminal and an interior point, the insulating material near the terminal is thickened.

714,973. MEASURING ALTERNATING ELECTRIC CURRENTS; M. E. Thompson, Ridgway, Pa. App. filed Dec. 30, 1896. A second field coil having a circuit of high self-induction, a third field coil deriving its current independently of the second field coil and a closed armature in inductive relation to all the coils.

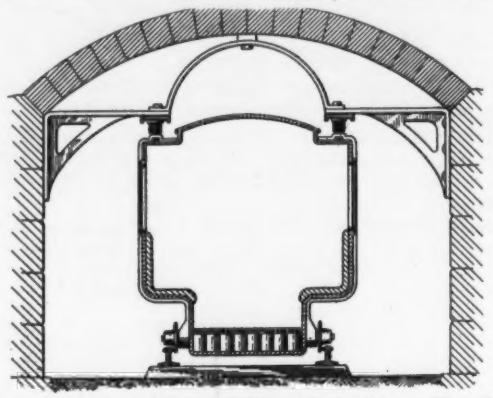
715,016. MANUFACTURE OF SPONGY LEAD PLATES FOR SECONDARY BATTERIES; H. W. Butler and J. H. May, London, Eng. App. filed Jan. 2, 1901. Lead oxide and an organic substance on a grid are first connected with the positive pole of the source of electricity to oxidize the organic substance and convert the lead oxide into porous peroxide and then passing the current in a reverse direction to reduce the porous peroxide to spongy lead.

715,019. MEANS FOR SYNCHRONIZING MOTORS; F. E. Case, Schenectady, N. Y. App. filed Feb. 11, 1899. Motors in series with means actuated by an increase in electromotive force of any motor above that of the others for diverting current from such motor to the others.

715,036. TROLLEY HARP; H. S. Doyle, St. Louis, Mo. App. filed Aug. 15, 1902. A spring fork between which the wheel is mounted arranged with nuts to screw up and down to alter the spring pressure.

715,043. CURRENT OPERATED RECEIVER FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed Aug. 27, 1902. (See Current News and Notes.)

715,058. ELECTROMAGNETIC BRAKE; F. Haber, Washington, D. C. App. filed April 21, 1902. To obtain an extended movement of the brake lever



714,851.—Railway and Car and Magnetic Appliances Therefor.

under the action of a magnet, the lever carries a series of armatures, one above the other, which successively come to rest against the head of the magnet.

715,071. ELECTRIC TROLLEY PROTECTOR; W. W. Hoffman and F. W. Powers, West Lafayette, Ind. App. filed April 18, 1902. A spring retractor acting upon the trolley rope.

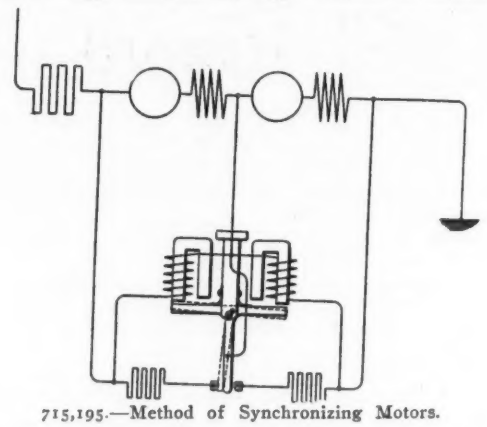
715,126. RECTIFIER FOR SINGLE OR POLYPHASE ALTERNATING CURRENTS; A. Nodon, Paris, France. App. filed April 30, 1902. An electrolytic transformer comprising an electrolyte, a vessel for containing the same, an electrode made of an alloy of ninety-five per cent. aluminum and five per cent. zinc, and another electrode made of iron, or its alloys, and terminals connected with said electrodes.

715,160. MAGNETIC SEPARATOR; C. Scholl, Goppingen, Germany. App. filed Sept. 13, 1901. Details.

715,170. HOT WIRE ELECTRIC METER; R. S. Stewart, Detroit, Mich. App. filed April 26, 1902. A pointer is suspended horizontally from two wires, the current in which lengthens or shortens the wires and so alters the angle of the pointer.

715,190. TROLLEY CATCHER; E. M. Zwing, Philadelphia, Pa. App. filed Aug. 30, 1902. The quick upward movement of the trolley releases a brake which then acts upon the trolley rope.

715,195. METHOD FOR SYNCHRONIZING MOTORS; F. E. Case, Schenectady, N. Y. App. filed Feb. 11, 1899. Consists in simultaneously cut-



715,195.—Method of Synchronizing Motors.

ting down the current in any motor that slips and increasing it in those of lower speed.

715,203. SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed Nov. 13, 1902. (See Current News and Notes.)

715,209. FACE PLATE FOR ELECTRIC COUPLINGS; N. Marshall, Newton, Mass. App. filed Nov. 7, 1900. Details.

715,220. METHOD OF MEASURING ALTERNATING ELECTRIC CURRENTS; M. E. Thompson, Ridgway, Pa. App. filed Dec. 30, 1896. The method of obtaining a magnetic field in quadrature with the impressed electromotive force, which consists in lagging a current derived from said electromotive force, producing thereby a lagging primary magnetic field, producing independently of said primary magnetic field an auxiliary magnetic field, and combining such primary and auxiliary fields to form a resulting field of the required phase relation.